CHAPTER XVIII.

CULTURE AND CURING OF TOBACCO IN WISCONSIN.

A line extending northwest from Milwaukee will nearly mark the limit between the small timber of the openings and the heavily timbered regions of the north, and the same line will almost mark the boundary between the agricultural and the lumbering districts.

The soils of central Wisconsin are divided, according to their origin, into drift, sandstone, limestone, and crystalline rock soils, and all partake of the character of the rocks from which they are derived. The Potsdam sandstone, which occupies a large district in central Wisconsin, gives a very poor, thin soil, and even where the material of the drift is of an arenaceous character the soil is often of the same nature.

If the drift material is of a calcareous and argillaceous character, though it may overlie sandstone, the soil is often good, as in the southern part of Adams and the eastern part of Waushara counties. Some few local areas of moderate fertility occur on the Potsdam formations, but they result from the accidental accumulation of other material, and are exceptions to the general rule.

A bed 30 feet thick, which rests above the lowest sandstone, is composed of a clayey or sandy magnesian limestone, called the Mendota limestone, and where the soil has been derived from this, as in portions of Columbia county, it is fertile. Upon this is another sandstone, with a thickness of from 30 or 40 feet, to which the name of Madison sandstone has been given. In its disintegration it makes a very poor soil, being nothing more than a bed of loose sand. This occurs in a part of Columbia county. The Lower Magnesian rests upon the Madison sandstone, and gives rise, by its crumbling, to a very fertile, durable soil. This limestone is from 8 to 200 feet in thickness, and is composed largely of siliceous and clayey matter. The elevated prairie belt of northern Dane and eastern Columbia carries this soil, and is one of the most productive regions in the state.

The Saint Peter sandstone rests upon the Lower Magnesian, but it rarely forms the surface rock, and is therefore of no importance as a soil-former. But few areas in central Wisconsin have soils derived from Trenton limestone or from the Galena.

The lead region embraces three of the most southwesterly counties of the state, viz: Grant, Iowa, and La Fayette. In the eastern part of La Fayette county the soil is sandy, owing to the disintegration of the calcareous sandy shales belonging to the Galena limestones.

South of the principal water-shed of the district the soils rest upon a strong, deep clay. These soils have been derived from the crumbling of the Galena limestones and the Cincinnati shales, and are remarkable for their fertility and strength. In other places, especially north of the water-shed, the soil abounds in flint on the higher points, derived from the Galena limestone.

TIMBER.

Nearly all the northern counties of Wisconsin abound in white pines, balsams, hemlocks, and other conifers. The widely extended prairies of western Illinois reach into several of the southern counties of Wisconsin, and between these prairies and the heavily timbered districts of the north are what are called "oak openings", in which the burr oak (*Quercus macrocarpa*) is the principal growth. Associated with this burr oak are the white oak (*Q. alba*), red oak (*Q. rubra*), and pin oak (*Q. palustris*). The chestnut oak (*Q. prinus*) occurs in the region around Janesville and Edgerton, the very center of the tobacco district.

CLIMATE.

In the southern and thickly-settled portion of the state the mean annual temperature varies from 45°.3, on the shores of lake Michigan, to 46°.9, on the Mississippi river, the average being about 46°.

For the tobacco-growing region around Janesville, Edgerton, and Madison the following table will give a fair idea of the prevailing meteorological changes:

	Latitude.	Longitude.	Height.	Spring.	Summer.	Autumn.	Winter.	Annual mean.
Edgerton	42.88	89.00	1,700	46.17	70.84	48.42	21.30	46.68
Janesville	42.41	89.00	780	44.73	70.43	48.25	20.84	46.07
Madison	43.15	89.24	1,088	43.47	69.11	48.20	20.84	45.40

The rainfall, including melted snow, averages for this region about 32 inches annually, of which about one-half falls in May, June, July, and August. The prevailing winds for the spring months are from the northeast; of summer, southwest; of autumn and winter, west. The mean of the prevailing winds for the region of the Mississippi river is south; for lake Michigan, northwest. The winters are usually cold, clear, and dry; springs, backward; summers, hot; and autumns, mild and pleasant.

HISTORY OF TOBACCO CULTURE IN WISCONSIN.

The census of 1850 reports the entire product of the state at 1,268 pounds. The first attempt to grow tobacco for market in Wisconsin was made near Madison by Ralph Pomeroy and by J. J. Heistand. There was not much, however, raised up to 1860, for the census returns show the whole amount grown in the state at that period to have reached only 87,340 pounds. Of this amount Walworth county produced 26,400 pounds, Rock 23,340 pounds, and Dane 8,968 pounds. An impression prevailed for many years that tobacco could not be profitably grown in high latitudes, and it was not until the value of the northern-grown leaf as a wrapper for Havana fillers was ascertained that it took a permanent place among the productions of the farm. The occurrence of the civil war, by making tobacco scarce and dear, gave a powerful impetus to its culture, and it was at this period that it began to claim the attention of some of the best farmers in Dane county; but its culture spread slowly, there being much prejudice existing with a large class of farmers against its production, and it was believed that it would quickly exhaust the fertility of the soil; that it was a useless product; that it ministered to a depraved appetite; and that the extension of its culture would be an unmixed evil. It gradually increased, however, in acreage, so that the census of 1870 showed a production of 960,813 pounds—an increase of just 1000 per cent. in ten years—Dane and Rock counties producing eight-ninths of the whole, the former 229,568 pounds, and the latter 645,508 pounds. Since that time its cultivation has spread over nearly the whole of Rock county, the southeastern portion of Dane, the eastern part of Greene, and the southwestern corner of Jefferson. In 1870 the production was very largely increased, and the crop that year, which was chiefly sold in Edgerton, was estimated to be worth $200,000, and that of 1871 between $300,000 and $400,000. Since that period it has formed a staple crop, and the farmers in Dane, Rock, and small portions of the adjoining counties rely upon it with more certainty as a money crop than upon any other staple grown; the production up to 1876 varying from 10,000 to 15,000 cases of about 400 pounds each.

THE TOBACCO DISTRICT OF WISCONSIN.

If one will take a map of Wisconsin and begin about three miles west of Madison, the state capital, on the shore of lake Mendota, and trace a line nearly south, so as to include the eastern half of the townships of Brooklyn, Albany, and Decatur, in Greene county, and the northeastern corner of Spring Grove township, in the same county, and then curving into Rock county, so as to exclude the southern half of the southern tier of townships in that county, passing north of Beloit about two miles, and striking the western limit of Walworth county near Allen's Grove, following the eastern boundary of Rock county north about two-thirds of its length, then turning to the northwest, so as to include lake Koshkonong, in Jefferson county, and from this point trace the line in a northeasterly direction to the very center of Jefferson county, and from the latter point in a line curving first north as high as Prairie, then southwesterly to the beginning, inclosing within the boundary something over 1,200 square miles, he will outline the limits of the tobacco-growing area of Wisconsin in 1879.

In the tobacco district of Wisconsin the area in 1879 was an increase of 17 per cent. over that of 1878, and of about 60 per cent. increase on that of 1877 and 1876. The yield was greater in 1879 than in 1878, but less than it was in the two years preceding. The quality of the crop, however, was inferior, having been very much injured by worms—a very rare occurrence—and in some local areas by hailstorms. The crops of 1878, 1877, and 1876 were very sound, and elevated the rank of the Wisconsin crop in the markets of the country. The main cause of the decrease in yield in the years 1878 and 1879, as compared with the two years preceding, was the extended culture of Spanish tobacco, a variety that always commands a ready sale, but does not yield as much per acre as the larger seed-leaf varieties. The Havana or Spanish varieties are exceedingly delicate in texture, with a peculiar aroma, and probably one-fourth of the whole amount grown in the state, and nearly one-half of the area planted, is of the latter varieties. While the yield does not exceed 1,000 pounds per acre, it sells readily for 11 cents per pound. The seed-leaf varieties, though yielding 1,600 pounds to the acre, do not bring in the local markets over 6½ cents through. The readier and earlier sales of the Spanish tobacco make it far less troublesome to the tobacco-growers, and it does not meet with such sharp competition in the markets as the seed-leaf.

Several varieties of the seed-leaf, however, are grown, among them being the Lancaster broad leaf, the Connecticut broad leaf, and the Vallandigham. The Lancaster broad leaf, generally preferred by the tobacco-growers of Jefferson county, has a delicate fiber and a silky appearance, and shows some slight modification, owing to the climate and soil, when compared with the same variety grown in Lancaster county, Pennsylvania. This variety loses in body but increases in fineness of leaf, and its capacity for moisture is increased 4 or 5 per cent.

The Connecticut broad leaf, or, as it is called by some, the East Hartford Connecticut leaf, is preferred by many on account of its superior yield. Though its color is inferior, being lighter than the Pennsylvania seed-leaf, it has a coarser fiber, but a very thin, delicate web. It has a drooping leaf in growing, while the Lancaster grows with an upright leaf, resembling in this particular the Cuba varieties, and the leaf is ruffled and corrugated. This is doubtless the same variety known in Pennsylvania as the Glessner, a variety highly prized for its excellence as a wrapper.

The Vallandigham is cultivated to a considerable extent in the neighborhood of Edgerton, Rock county, and has a large, pointed, smooth leaf, which makes it easy to worm.

All these varieties of seed-leaf are used for wrappers, fillers, and binders in cigar-making, the inferior grades being often mixed with southern leaf, in the proportion of one to four, for making fine-cut smoking tobacco.

The Cuba varieties, for the reasons already mentioned, are growing rapidly into favor. After three or four years' planting from seed originally brought from Cuba these varieties lose much of the aroma which distinguishes them the first year, but the size of the leaf is greatly increased, and enough of the sweet flavor is retained to make the product of great value; for as the amount of sweet fillers is decreased the ratio of wrappers to the whole is increased, and it is a question among growers whether the change is not, on the whole, a benefit rather than an injury—an improvement rather than a deterioration in the variety.

SOILS FOR TOBACCO.

Three classes of soils are recognized by the tobacco-growers in Wisconsin: 1. The calcareous sandy soil. 2. The clayey soils, light and heavy, mulatto in color. 3. The prairie soils.

The first is greatly preferred, not only because it is more easily tilled, but because the quality of tobacco grown upon it commands a higher price and readier sale. It produces a silky, elastic, glossy leaf, uniform in color, and the plant matures fully a week earlier than the clayey soil. The timber growth is chiefly white and burr oak, with hazel undergrowth. Sometimes this soil is found on the prairie lands. The clayey soils occupy more elevated areas, with open woods, the principal arboreal growth of which is white and burr oak, with maple on the heavier soils.

The tobacco grown on clayey soils is coarse, thick, not uniform in color, and is generally of an inferior quality in every way. The lighter the clay the better the tobacco.

The prairie soils are extremely variable in their adaptability to the growth of tobacco. Where there is a predominance of clay, and when these soils are of a black, waxy character, they are totally unfitted for the production of fine leaf, but with a suitable admixture of sand they belong really to the class first mentioned, and have the capacity of producing tobacco of a most desirable quality. The largest proportion of tobacco land in Jefferson county is prairie.

It has been ascertained by experience that the presence of gravel in a dry season is a great disadvantage to the tobacco-plant, but in a wet season it proves of benefit, inasmuch as it allows the superfluous water to drain off.

The slopes which run down to the shores of the lakes, and more especially the eastern slopes, in which there is a variable quantity of feldspathic, gneissoid, and limestone gravel, with sand in varying proportions, are found well adapted to the production of tobacco. Between the low bottoms on the streams and lakes and the elevated areas which rise up probably a hundred feet or more above the valleys are moderately undulating plains, in which, for the most part, the soils best suited for tobacco are found. Around Edgerton, which may be considered the center of the tobacco-growing region, there are many square miles occupying this medial topographical position, in which the light, marly clays and the calcareous, sandy loams abound. So also east and west of Janesville, for twelve or fifteen miles, the calcareous, sandy loams predominate. In the southwestern part of Jefferson, north and east of lake Koshkonong, the light, marly clays, well adapted to the growth of tobacco, abound; but the quality of the product grown upon these light clays is considered inferior to that grown on sandy loams or calcareous sands.

The prairie soils do not wash so easily as the more loose calcareous soils, the latter requiring considerable care in their cultivation, especially when the slopes are sharp, as they are liable to be damaged almost irreparably by heavy rain storms.

GRADES OF TOBACCO PRODUCT.

There are three grades of tobacco in Wisconsin: wrappers, fillers, and binders, the proportion of grades varying greatly with the seasons. If the season be entirely favorable, the proportion of wrappers will, in a good crop, reach 66 per cent. of the whole; but a very wet or a very dry summer will diminish this proportion to 50 per cent., or even less. Taking the average of crops and seasons, a fair estimate of the proportion of grades will be: wrappers, 50 per cent.; fillers, 25 per cent.; binders, 25 per cent. It is believed that the proportion of high grades has been very much increased during the past few years, and one reason given for such improvement, namely, that the tobacco is planted year after year upon the same land, is certainly an anomaly in agriculture.

The proportion of grades probably depends more upon the character of the soils than upon anything else. Tobacco grown upon new land, or land freshly cleared, has a harsh, woody, stiff leaf, but a pleasant flavor. Such tobacco furnishes a small proportion of wrappers, but a large amount of excellent fillers. It has but little gum, not enough to make it stand the sweating process well, and the color is light and the leaf thin. When the soil has been properly fertilized, there is an elasticity in the leaf which peculiarly fits it for wrapping purposes, and when tobacco is grown on such land the proportion of wrappers is largely increased and the inferior grades are reduced to a minimum. Level lands usually produce a much larger leaf than rolling lands, but it is not so fine, the tobacco grown on the latter commanding a higher price in market, while that grown on the former will make a heavier yield per acre. In many localities the seed-leaf is grown, for the most part, on level lands, and the Spanish varieties on rolling surfaces.

TOBACCO FERTILIZERS.

Fully four-fifths of the lands planted in tobacco are heavily fertilized with barn-yard manure, from ten to twenty loads being applied to every acre, at a cost varying from $10 to $20 per acre; and it not unfrequently occurs that the lands intended for other crops are robbed of their due proportion of manure in order that the tobacco lands may be enriched to their full capacity of production. This is plainly seen in the exuberant growth of the tobacco-plant and the scanty growth of some other crops. The tendency, however, is to a better preservation of the soil by increasing the manure piles and making use of the large deposits of muck which are so abundant in southern Wisconsin. Manure is applied broadcast, and is plowed or harrowed in a few weeks before the land is finally prepared for transplanting.

The effect of manures upon the yield and quality of the crop is very great, good, rich bottom-lands, without any recent application of manure, producing about 1,000 pounds of medium seed-leaf tobacco per acre; but with the application of ten loads of manure to the acre the yield is increased for the seed-leaf from 500 to 700 pounds, the quality being fully a third better, and the tobacco is darker, richer, and silkier. The increase in yield for the Spanish varieties is about 25 per cent., but manure does not appear to improve its quality to the same degree as with the heavier seed-leaf varieties. Instances are given where the same land has been planted in tobacco for a period of twenty-seven years in succession without any apparent diminution in its producing capacity. The land, however, has received heavy applications of manure every year. It is a very rare thing for any land, except that newly cleared, to be planted in tobacco without previously applying fertilizers. The few cases, however, reported show a decline in yield of at least 10 per cent. annually.

In the region immediately around Edgerton an increase in the yield of similar varieties is reported of 20 per cent. within the past ten years, but in Jefferson county a decrease of 10 per cent. within the same period is given. This difference is due to the fact that near the former place only heavily manured lots are planted in tobacco, while in the latter a larger proportion of newly-cleared lands is used for growing tobacco, and, as is probably the case, the best tobacco lands were the first cleared, leaving the inferior new lands to come in later. In Rock, Dane, and Greene counties the general practice among tobacco-growers is to keep the same field year after year in tobacco, the land receiving a heavy coating of manure every year; and in this way there is, so to speak, a cumulative strength given to the soil, no one crop being sufficient to exhaust the manure applied for its production. The soil, therefore, is constantly improved and enriched, and each successive crop shows a larger yield. In Jefferson county, on the contrary, the schedules show that the principle of rotation is practiced to a considerable extent. After tobacco comes wheat, followed by clover, and then corn, after which comes tobacco again. Notwithstanding the fact that the farmers in a large portion of the tobacco-growing district do not practice green-manuring or rotation, it is admitted that it would add to the friability of the soil and make it more retentive of moisture during the summer months.

Losses in the crop not unfrequently occur from "brown-rust" or firing, and a few days' delay in housing will sometimes reduce the quality of the tobacco fully one-half. "Brown-rust" is a disease resulting from the combined effects of hot weather and a superabundance of heat-producing manure in the soil.

All reports, however, concur in saying that the general quality of the crop during the past ten years has been greatly improved in consequence of increased care and attention in housing, curing, and assorting. The increased knowledge, too, among farmers has led to a better selection of soils, which, when once proved congenial to the growth of tobacco, are set apart for that purpose, and are kept up to a high degree of fertility.

Of the tobacco lands in cultivation probably two-thirds were originally prairie, with a calcareous, sandy loam; the remainder originally oak openings, with hazel undergrowth. Probably only 4 or 5 per cent. of the soils adapted to the growth of tobacco are occupied in its cultivation in the counties under consideration.

SEED-BEDS.

The seed-beds are burned lightly with brush, and a liberal supply of hen manure or horse dung is worked into the soil to the depth of 6 inches with a hoe or a spade. The work of preparation often begins in July, when the manure is applied. The bed is reworked in August and again in September, for the purpose of keeping down any weeds or grass that may spring up, and finally, in November, it is hoed and raked and prepared to receive the seed, which is either sown in the fall or early in the succeeding spring. When sown in the fall, the seed is not previously sprouted. After sowing, the bed is compacted by rolling, tramping, or clapping with a board. The plants are carefully nursed by liquid manuring, and by keeping the grass and weeds pulled out. By proper care, they will be large enough for transplanting in the field by the 1st of June.

PREPARATION OF TOBACCO SOIL.

The land for the succeeding crop is plowed in the fall, immediately after the tobacco is harvested. This checks the growth of suckers, which always shoot up from the old stubble, and are gross feeders, furnishing also a refuge for worms. The breaking is done with a two-horse turning or stubble plow to the depth of 5 or 6 inches. About the first of the succeeding May the soil is again broken with the same plow, and a third time about the first of June, or just before the plants are ready for transplanting. Manure may be applied at any time before either plowing. Coarse manures are better when applied in the fall, but fine, well-rotted manure is usually spread over the land just before the second or the third plowing. Some do not apply manure until after the third plowing, when it is harrowed or dragged in. After being thoroughly pulverized with a harrow or drag, the land is marked off: if for seed-leaf, 2½ by 3 feet, some preferring 4 by 2 feet; if for the Spanish varieties, 3 by 1½ feet. Hills are generally made with a hoe at the intersection of the lines and "patted" so as to compact the earth; but when only lined out one way, they are made on the line at proper distances. Sometimes no hills are made, but the plants are set out on the side of the lines. The plants are generally set out immediately after a shower of rain, but when water is convenient, and the plants are becoming overgrown in the beds, artificial watering is often resorted to. The planting is done from the 1st of June to the 4th of July, but these are extreme limits. The great bulk of the crop is set out from the 10th to the 20th of June.

By an easy calculation, it will be seen that, of seed-leaf, from 5,445 to 5,808 plants are set to the acre, and of the Spanish varieties 9,680 plants, a larger number to the acre than is planted in any other tobacco district in the United States. To this cause is no doubt due the exceeding tenuity and tenderness of the Wisconsin tobacco.

CULTIVATION OF THE TOBACCO CROP.

As soon as the soil is in proper condition to work after the plants have been set out a cultivator, with five teeth, is run between the rows, and this is kept up once or twice a week, until the field has been gone over five or six times. The crop is hoed twice, once after the cultivator is run through the first time. Very little dirt is put to the plant, level cultivation being preferred. In some portions of the district a horse-hoe is used in cultivating the crop, which, by its peculiar construction, enables the farmer to go very near the plant and stir every part of the soil. In very small patches the cultivation is done entirely with the hoe, which is kept up every week until the plants are so large that they cannot be worked without breaking the leaves.

TOPPING AND SUCKERING OF TOBACCO.

In about forty-eight or fifty days after the plants are set, if the crop has been well cultivated and the weather seasonable, the flower buds make their appearance, and are pinched out, leaving from fourteen to sixteen leaves on each plant. None of the bottom leaves are taken off, but all are left to mature or dry up, serving as a protection against the dirt. Fields, however, are often seen in full blossom before the tobacco is topped, and this results in great damage to the crop. Tobacco is suckered twice: once in about a week after it is topped, and again just before it is cut, which is generally about two weeks after topping.

As has been noted, tobacco is generally ready for harvesting in two weeks after being topped, and yet there is considerable variation in the time on different soils. On warm, sandy loams the plant will be as ripe in twelve days as it will be on heavy clayey soils in eighteen days. This is one of the reasons why the sandy loams are preferred.

TOBACCO INSECTS.

Fortunately for the tobacco-growers of Wisconsin, the horn-worm, the great enemy of the tobacco-plant in other states, has never appeared in great numbers, the farmers ascribing their immunity from them to the frequent plowings which they give the land before planting, thus disturbing them in their beds while in the chrysalis state, some of them being covered so deeply that they are not able to extricate themselves, while others are thrown to the surface and are devoured by fowls. The severity of the winters also destroys a considerable number. The farmers carefully search every leaf that indicates their presence. Grain is sometimes thinly scattered on the tobacco-fields and fowls are driven upon them, and while hunting for the grain they gather many of the worms. This mode is not reported from any other section.

CUTTING, HOUSING, AND CURING OF TOBACCO.

Harvesting begins early in August and continues without intermission into September. A large portion of the crop of 1880 was harvested during the first and second weeks in August. The time of day preferred for cutting is from two o'clock in the afternoon until nearly sundown, because at that time tobacco is less liable to be blistered by the heat of the sun. The instrument used for cutting is a hatchet, the plants being cut off nearly on a level with the ground and laid back on the rows to wilt. After wilting they are speared on laths. Of the large seed-leaf varieties only about six plants are put on a lath, but of the smaller Spanish or Havana varieties ten are not considered too many. After being speared on the laths, the latter are carefully put on a long wagon-frame, made for the purpose, and carried to the sheds, where they are arranged on the tier-poles, or racks, from 6 to 10 inches apart, according to the size of the plants, but never so close as to permit them to touch each other.

It requires six weeks to cure the Spanish varieties perfectly, and two months to cure the seed-leaf. If the weather is dry after the crop is housed, the doors are kept closed during the day and opened at night, but extreme care must be taken not to cure too rapidly. In muggy, sultry weather as much air as possible should be given, thorough ventilation being indispensable to prevent pole-sweat. Continuous damp weather or continuous dry weather are both to be feared. It is believed by many good growers that white veins are the result of a drought after the tobacco has been harvested, and it is said that no crop cured when there is plenty of rain is ever affected with them. Inferences of this kind, however, are too often drawn without considering a sufficient number of cases to warrant the enunciation of a general law. It is a well-established truth, however, deduced from the universal experience of the cultivation of seed-leaf tobacco in every state, that a crop cannot be well cured without the alternations of moist and dry atmosphere.

TOBACCO-HOUSES.

The tobacco-houses, or sheds, are generally very inexpensive frame buildings, 14 feet high, 28 feet wide, and long enough to harvest whatever number of acres the farmer may wish to raise. The height between the tiers is usually 4½ feet, which allows ample room for ventilation. The height of the shed gives three tiers from top to bottom, allowing half a foot between the tails of the tobacco hung on the lower tier and the ground. The capacity of these sheds varies from 2 to 12 acres, and many of them very rickety and open, and are totally unfit for the purpose. The tendency, however, is toward improvement, for observing farmers have discovered that to cure tobacco properly it is necessary to be able to control the conditions which surround it. The cost of the best sheds at present does not exceed $600.

PREPARATION OF TOBACCO FOR MARKET AND PRICES.

From the 15th of November to the 1st of January is the usual period for preparing the crop for market. The usual practice among farmers is first to strip the leaves from the stalks, tying them up in large bundles and assorting afterward. A few assort directly from the stalk, but "table assorting", or assorting after stripping, is preferred by the most painstaking farmers. After the tobacco has been carefully assorted into three or four grades, generally first wrappers, second wrappers, fillers, and binders, it is tied in "hands" of from eighteen to twenty leaves, securely wrapped with a leaf at the butt-end, and "bulked" or "banked" in piles, with the heads out and tails overlapping in the center of the bulk. Here it remains until the "fatty stems" are thoroughly cured, when it is ready for market, unless the grower prefers to pack it in boxes himself. The selling goes on all through the winter, and even up to May. In all the towns and villages of any considerable size in the tobacco-growing region there are established what are known as warehouses, where dealers buy, pack, and sweat the crop, preparatory to sending it to more distant markets. In the town of Edgerton there are thirteen of these warehouses, and it is estimated that during the year 1879 fully half a million dollars was disbursed among the farmers in the immediate vicinity for tobacco.

Stoughton has five warehouses, and the amount disbursed in 1879 in the purchase of tobacco was about $214,000. Janesville has one, which pays out $40,000, and Evansville one, where $25,000 was disbursed during the same year. Several other places, as Madison and Milton, have recently entered into the business of buying and packing tobacco, and there is no other crop grown in the state which gives such animation to trade, or which supplies the farmers so surely with ready money. The total expenditure in 1879 by local dealers in the state for tobacco delivered loose was estimated to exceed $890,000.

The following were average prices paid for crop through (that is, including all grades) for the product grown in the annexed years, but sold in the market the following years:

Year.	Seed-leaf.	Spanish.
	Cents.	*Cents.*
1875 (frosted)	4	None.
1876	6	8
1877	6½	8
1878	6½ to 7	9
1879	7	12

When sold by grades the following prices prevailed in 1879:

Grade.	Seed-leaf.	Spanish.
	Cents.	*Cents.*
Fillers	2 to 4	4
Binders	4 to 7	8
Wrappers	8 to 15	16

The crop of Spanish tobacco, when sold loose, averaged 11 cents round in 1879.

The crop of 1879 was damaged to some extent by winds and storms, and while the average price of the crop of seed-leaf did not exceed 7 cents per pound, the better crops readily brought from 8 to 10 cents.

LANDS, LABOR, AND COST OF TOBACCO PRODUCTION.

The price of tobacco lands in Wisconsin ranges from $35 to $75 per acre, the average being about $50. When rented, land commands $10 per acre, or one-half of the crop prepared for market, the landlord furnishing sheds and team, but not boarding the tenant. The price of labor is $30 a month for men, $1 25 per day, or $150 per year, board included. In such cases tobacco laborers command about $5 per month more than other field hands. Strippers of tobacco are paid $1 per day, and to strip from 150 to 250 pounds is considered a fair day's work. Packers are paid $1 25 per day. A good man, with help, during the season of harvest, can plant and cultivate five acres of tobacco.

The following detailed estimate of the cost of cultivating, curing, and marketing an acre of seed-leaf tobacco was made by Mr. Thomas Hutson, of Edgerton, one of the largest and most successful growers in Rock county:

DR.	
Cost of making seed-bed for one acre	$0 50
Cost of seed	50
Weeding and attention to seed-bed	1 00
Rent of land (interest on price, at 10 per cent.)	5 00
Stable manure, six cords, cost	6 00
Cost of applying same	6 00
Cost of breaking one acre three times	3 75
Harrowing, lining out, and hilling	1 50
Drawing and setting out plants	3 00
Cultivating and hoeing	7 00
Topping, 25 cents; worming, 50 cents; suckering, $2 50	3 25
Harvesting	5 00
Taking down, assorting, and stripping	12 00
Bulking	25
Use of barn, laths, wagon, etc	5 00
Delivering crop to market	1 50
Total cost	61 25
CR.	
By 1,600 pounds of tobacco, at 7 cents	$112 00
Profit	50 75
Cost, $3 83 per hundred pounds.	

It is believed that the cost will be reduced in a crop large enough to employ a full set of hands; that is, hands enough to handle the crop most expeditiously and to employ the team to its full capacity. As the Spanish varieties bring a much higher price, though not yielding so much per acre, it is probable that they pay as good if not a better profit than the seed-leaf. The estimated cost of production for the whole state may be stated as $4 95 per hundred pounds.

PECULIARITIES OF WISCONSIN TOBACCO.

The burning qualities of the Wisconsin tobacco are generally excellent, leaving as a residuum a whitish solid ash, much diminished in size from the original bulk. The tobacco is peculiar in holding more water than any other grown in America; is always limp, and retains its humid, flexible properties during the coldest weather, but loses from 18 to 20 per cent. during the sweating process. The Wisconsin tobacco has great uniformity in color, being a dark brown, but the leaf is extremely thin, and often lacks substance. When it has been resweated it very much resembles the Connecticut seed-leaf in texture, though somewhat darker in color. It then has a very fine finish, and but for its tenderness would take a very high rank among cigar manufacturers. The same humidity is observed in the Havana or Spanish leaf, and this excess of moisture often causes it to damage during the sweating process. It is probably owing to this excessive presence of water that the Wisconsin tobacco is so uniform in color.

MISCELLANEOUS.

Hailstorms are sometimes very destructive, one which occurred in 1878 destroying in the vicinity of Edgerton 10 per cent. of the crop. These storms occur more or less every year, but usually in narrow belts.

Cases $2\frac{1}{2}$ by $2\frac{1}{2}$ by $3\frac{1}{2}$ feet, suitable for packing tobacco, cost $1 each, from 300 to 450 pounds being packed in a case. New York buyers pay local agents $1 per case for buying.

A day's labor is ten hours when the laborer is employed for one day only, but if he is employed by the month twelve hours are reckoned a day's work.

Artificial sweating is believed by some of the best dealers to be accompanied with less risk than sweating by the natural process, and the second stories of warehouses are sometimes prepared as sweating chambers by being plastered or closely ceiled. These are heated by furnaces, and the temperature of the rooms is kept at 110° to 140°. About forty-two days are required to complete the process, when the tobacco is ready for market.

Any one can become an inspector by guaranteeing the samples drawn from a case to represent correctly the quality of the tobacco and its condition in the case. These samples are, however, usually drawn by inspectors sent out from other places, or by agents representing houses in other cities.

The great bulk of the tobacco, after being cured and sweated, finds its way to New York, Philadelphia, Baltimore, Cincinnati, Saint Louis, Hartford, and other points where there is a regular demand for cigar tobacco, and is marketed at all times. Farmers, however, usually deliver the crop to local dealers in the winter and spring, and the latter usually keep a supply on hand throughout the year.

The tobacco product of Wisconsin is the tenderest of all the seed-leaf products, and in working must be handled with great care. In consequence of the great absorptive capacity of the leaf, much of it is damaged by extreme fermentation during wet, hot weather. Nor does it answer well for exportation, the sea sweat greatly damaging it.

The following statement will show the production, acreage, yield per acre, and value of the Wisconsin crop for the four years ending in 1879, the figures for the latter year being from the census returns:

Year.	Production.	Acreage.	Yield per acre.	Value in primary markets.	Value per pound.	Value per acre.
	Pounds.		*Pounds.*		*Cents.*	
1876......	7,572,362	5,568	1,360.00	$511,134	6.75	$91 80
1877......	7,265,602	5,504	1,320.00	508,592	7.00	92 40
1878......	9,082,002	7,506	1,210.00	653,904	7.20	87 12
1879......	10,608,423	8,810	1,204.13	899,118	8.47	101 99

CHAPTER XIX.

THE NEW ENGLAND TOBACCO-GROWING DISTRICT.

HISTORICAL NOTES.

The culture of tobacco in the Connecticut valley is almost coeval with its first settlement. As early as 1640 an act was passed restricting the use of tobacco to that grown in the colony, under a penalty of 5*s.* for every pound expended for imported tobacco, "except a license should first be obtained from the court." Under this restriction the culture, as well as its use, became general, and efforts were made by the colonists in 1646–'47 to curtail its consumption by a prohibitory law, which acted upon the consumer, but not upon the merchant, trader, or farmer. This law provided that no one under the age of twenty years, nor any other person who had not become addicted to the habit, should take any tobacco without a certificate from a physician that it would be beneficial to him. It also provided that tobacco should not be taken publicly upon the streets, under the penalty of sixpence for each offense.

In 1662 a duty of 25*s.* per hogshead, or 2*d.* per pound, was laid upon all tobacco brought into the colony. In 1753 inspectors were appointed to examine the tobacco for shipment abroad, and to take out all that was in any way injured by frost, heat, moisture, or in other manner, and to pack only the sound, well-ripened, well-cured tobacco, which should in every way be good and merchantable. For this service the owner was required to pay 5*d.* for every hundred-weight and 3*d.* per mile for travel of the inspector, and all tobacco sold without inspection was declared forfeited.

At no period previous to 1801 did the production of the Connecticut valley exceed 20,000 pounds, and it was shipped for the most part to the West Indies, being purchased at from $3 to $3 33 per hundred pounds by local merchants, by whom it was packed and exported.

About 1801–'2 tobacco was manufactured in a small way by individuals; but it was not until 1810 that cigar manufactories were established—one at East Windsor and another at Suffield, Connecticut. Spanish tobacco, imported from Cuba or the Brazils, was then for the first time employed in the fabrication of cigars, and these were peddled in wagons throughout the country.

The year 1825 marked a new era in the history of tobacco culture in the valley, and a packing-house was erected at Warehouse Point, about 3,200 pounds being packed and shipped to New York. This tobacco was packed in bales, inclosed with boards on four sides, leaving the ends exposed, and weighed about 100 pounds each. The cultivation was gradually extended, and in 1840 it was a general crop, though small, grown as regularly as any other in the valley.

Previous to the year 1833 a variety of tobacco, with a very narrow leaf, called the Shoestring, was cultivated, which, though strong and heavy, was not well adapted to the purposes for which Connecticut tobacco is now used. About this time a broad leaf variety was brought from Maryland, having a very delicate, thin, silky leaf, regular veins, comparatively tasteless, of fine finish, and very pliant. B. P. Barber, of East Windsor, Connecticut, has the credit of introducing this tobacco, which has, by skillful and intelligent management, established a reputation second to none grown in the United States.

Meanwhile factories were erected from time to time, until in 1856 about four hundred men and two hundred women found employment in making cigars at various points from Springfield, Massachusetts, to Middletown, Connecticut, the average wages earned by men being $6, and by women $4 per week. (*a*) In 1860 there were forty-five of these establishments, with a capital of $389,600, employing 731 persons, at an annual expenditure for wages of $274,911 and for material of $381,150, turning out an annual product estimated to be worth $914,500. In 1870 there were in Connecticut alone one hundred factories making cigars and manufacturing tobacco, employing 719 hands, with a capital amounting to $409,750, expending for wages $303,109, for material $441,663, and turning out a product valued at $1,133,665.

The demand for raw material created by these manufacturing establishments rapidly stimulated production, and the prices paid were highly remunerative, almost every farmer living within convenient distance for delivery, and who possessed lands suited to the growth of tobacco, endeavoring to supply the demand.

Mr. Henry A. Dyer is authority for saying that in 1840 1,800 cases, or about 720,000 pounds of tobacco, were packed in the Connecticut valley. The census for that year reports only 537,649 pounds for all New England, being the crop of 1839. In 1842 the estimated crop in Connecticut valley was 5,000 cases, or 2,000,000 pounds, and in 1845 the product of Connecticut alone was 3,467,940 pounds, as given in a state statistical report.

The first tobacco grown in the Housatonic valley for market was in 1845, in Kent, Litchfield county; the next was grown near New Milford; and in 1870 it became one of the leading products of the valley. Housatonic tobacco became very popular in 1876 for cigar wrappers, and thereafter the increase of product was very rapid.

TOBACCO PRODUCT.

The following table shows the production of New England for each of the census years from 1840:

States.	1840.	1850.	1860.	1870.	1880.
Connecticut	471, 647	1, 267, 624	6, 000, 133	8, 328, 798	14, 044, 652
Massachusetts	64, 955	138, 246	3, 233, 198	7, 312, 885	5, 369, 436
New Hampshire	115	50	18, 581	155, 334	170, 843
Vermont	585	....	12, 245	72, 671	131, 432
Rhode Island	317	....	708	796	785
Maine	30	....	1, 583	15	250
Total	537, 649	1, 405, 920	9, 266, 448	15, 870, 499	19, 717, 398

Beginning with the year 1855, Massachusetts has taken a state census, intermediate between those taken by the general government. The state census makes the following showing for 1855:

Counties.	Acres.	Value.
Berkshire	2. 0	$250 00
Franklin	93. 5	12, 403 00
Hampden	170. 5	21, 228 74
Hampshire	155. 0	23, 600 00
Total	421. 0	57, 481. 74

It does not appear how many pounds per acre were produced during this year; but if it be estimated at 1,666 pounds, which was the yield per acre in 1865, the average value was $136 54 per acre, and $8 20 per hundred pounds.

In the year 1865 the following statement is given in the Massachusetts state census:

Counties.	Acres.	Pounds.	Value.
Barnstable	0. 5	360	$90
Berkshire	166. 0	198, 800	29, 277
Bristol	3. 0	2, 420	777
Dukes	0. 5	800	150
Essex	5. 0	4, 850	1, 076
Franklin	1, 953. 0	3, 143, 799	516, 210
Hampden	1, 037. 0	1, 569, 643	308, 445
Hampshire	2, 409. 0	4, 394, 925	751, 654
Middlesex	5. 0	3, 405	732
Norfolk	0. 5	775	248
Plymouth	2. 0	1, 646	701
Worcester	36. 0	40, 218	7, 036
Total	5, 617. 5	9, 361, 641	1, 616, 396

a Connecticut Agricultural Report, 1856.

These figures show production per acre of 1,666 pounds; value per pound, 17.27 cents; value per acre, $287 74; an increase during the decade of 1,235 per cent. in total production, and an increase of value per pound of 9.07 cents, or 101 per cent.

The state census of 1875 shows the following acreage, production, and value:

Counties.	Acres.	Pounds.	Value.
Berkshire	69.25	89,600	$15,148
Bristol	0.25	530	78
Essex	0.75	1,000	80
Franklin	1,216.50	1.907.091	321,815
Hampden	808.50	1,224,670	230,475
Hampshire	1,652.25	2,655,561	462,950
Middlesex	0.12	240	53
Plymouth	....	70	10
Worcester	10.00	14,895	1,638
Total	3,757.62	5,993,666	1,032,262

This table shows production per acre, 1,595 pounds; value per pound, 17.22 cents; value per acre, $274 71; a decrease of production, as compared with 1865, of 36 per cent., and with 1870 of 18 per cent.

Previous to the year 1840 prices for the different grades ranged from $4 to $7 per hundred pounds. After that prices increased rapidly, and good wrappers were worth in 1857 $40 per hundred pounds.

The erection of numerous warehouses for packing tobacco finally resulted in making them sale houses as well as packing establishments. The custom has become general among farmers to sell their tobacco loose from wagons to the warehousemen at an agreed price for the crop through, the purchasers to assort, pack, and sweat the tobacco, shipping it for sale to such markets as offered the best net returns. Very few planters now assort and pack their own crop, as it is found to interfere very much with the production of another crop, requires more time than can be well spared from other farm work, and cannot be done as well nor as economically by the planter as by the dealer, who is provided with conveniently arranged houses and implements for the purpose.

SURFACE FEATURES.

Tobacco in New England is now cultivated in two well-defined regions: 1. The Connecticut valley. 2. The Housatonic valley.

The Connecticut valley is one of the finest regions in America, combining in an unusual degree a quiet beauty with great agricultural capabilities. The valley, so called, of the Connecticut river is about 300 miles in length, and is not far from 20 miles wide. The bounding hills are not, as a general thing, very symmetrical or rounded in outline, but have angular or irregular forms.

On the west the Connecticut valley is bounded by the Green mountain, the Hoosic mountain, and the great billowy plain which divides it from the Housatonic. On the east are the White mountains, culminating in Mount Washington, 6,428 feet above the sea. Mount Holyoke, 830 feet above the Connecticut river, which washes its base, and 900 feet above Boston harbor, is part of a greenstone range which, beginning with West Rock, near New Haven, runs northward across the state of Connecticut, entering Massachusetts between Springfield and Southwick, and at East Hampton, in Connecticut, it mounts into an elevation of over 1,000 feet, forming Mount Tom. The valleys on the north and west of Holyoke are very fertile.

GEOLOGICAL FORMATIONS AND SOILS.

A large area of the northern part of New Hampshire is covered by a series of greenstone or trap rocks, a compound of hornblende and feldspar. These occur in groups, and extend along the Connecticut river, through Massachusetts and Connecticut, to the sea-shore, and are believed to be metamorphosed sedimentary accumulations of the Silurian age. Although of a remarkable constancy in respect to their rock constituents and chemical composition, they frequently differ as to the relative proportions of these constituents, extensive granite and gneiss deposits, or sandstone, being frequently found in juxtaposition to the trap or greenstone, and in some instances limestones are found associated with feldspar and free quartz. In some granitoid rocks the feldspathic constituents predominate, in others the hornblende, and in others the mica, while apparently under less favorable conditions for metamorphosis the argillaceous sedimentary accumulations have retained to a considerable degree their original stratified amorphous character. Red sandstone ridges and trap rock also contribute largely in some parts of the valley to the striking beauty of the scenery along the river. The valley of the Connecticut river, like many of the New England valleys, has received extensive drift deposits, making thick beds of gravel, sand, clay, or fine silt, during the Champlain period. These drift deposits, composed for the most part of rounded pebbles, from the size of a goose egg to fine sand, are sometimes 100 feet or more in thickness, and show signs of stratification. In some places segregated beds of drifted sand appear, and in others beds of clay. These stratified and unstratified deposits have been modified by erosion.

The lands along the river rise on both sides quite frequently into terraces, and these level-topped elevations are the flood plains of the river, indicating distinct periods in the history of the erosion of the valley. The highest of these terraces extends over a wide area, and is cut here and there by the tributaries of the Connecticut river or disturbed by projecting hills. The lower terraces seldom extend over more than a mile or two, and on the opposite sides of the river these heights, unlike those of the highest terraces, are of different levels. The present flood plain is commonly known as meadows. The material which composes the highest plains is of a coarser character than that which contributes to the bottom lands or meadows; but before reaching Hartford these varying rocks have become ground into a fine material, and have commingled so thoroughly that all the elements find a lodgment in the soil; in fact, the areas covered by coarse material—due to immediate glacial action—are more extensive in the northern part of the valley than in the middle and southern portions. The superior physical condition of the soil upon the present flood plain of the Connecticut river is the principal cause of the high agricultural value of the lands along the river.

The more recent alluviums occur more or less in the valleys of all the streams, and form in the low depressions swamps and marshes. Sometimes the alluvium is composed of coarse material, very gravelly, and unsuited in a great degree for agricultural purposes; again it consists of very fine clayey or sandy loams; and when the sand and clay commingle in proper proportions the soil is generous in its fertility.

The tobacco area of the Housatonic valley is confined to Litchfield and Fairfield counties, spreading out westwardly so as to take in a small portion of the counties of Duchess and Putnam, in eastern New York. Only the northern part of Fairfield county, however, is embraced within this area, the southern part, as is the case with the southern part of Middlesex county, in the Connecticut valley, being, as is conjectured, too near salt water to produce tobacco of good burning qualities.

The Housatonic valley is narrow, and in many places can scarcely be said to have any bottom lands, resembling a deep gap cut through a high rolling region. Here and there small, semi-elliptical low fields or pockets are to be seen, covering a few acres, and these are succeeded by the plateaus of high terraces. These, in turn, are carved into so many fantastic shapes by ravines and small brooks as scarcely to be recognized as terraces. Beyond these, to the east and to the west, are long, sloping hills, irregular in outline, the sides of which are generally clothed with different species of the oak and the chestnut.

The soil of the country through which the Housatonic river flows is variable. What are called loamy soils in this valley are, for the most part, derived from the breaking down of the feldspathic and trappean rocks. These soils are very rich in potash, and are generally selected for growing tobacco. The alluvial soils vary much in quality, being at times white and argillaceous and very cold and tenacious, and at other times but little more than beds of gravel. When there is a proper commingling of these two the soil is very light, productive, and durable.

The soils of the tobacco-growing portion of New England may be divided generally into two classes:

1. Those formed from the crumbling of the rocks *in situ.*
2. Those which have been derived from transported material.

The soil derived from porphyritic rocks is a dark argillaceous loam, of excellent fertility, and is suitable for grain and for tobacco. The micaceous-ferruginous rocks supply a soil well adapted to the growth of grasses, and the rounded green hills attest the value of these lands for pasturage. It is a fine, light gray loam, works easily, and constitutes a considerable part of the soils of several counties.

The soils of the granitic rocks are inclined to be coarse in structure and arid, and where disintegration has been carried to a sufficient degree of fineness the soil is of moderate fertility. Slaty soils, from chloritic slates and mica-schist, are inclined to be cold and wet; yet, when sufficiently drained, they are strong, and will retain fertilizers well. They make a red clay or loamy soil. The red sandstones furnish a thin, poor soil, unless the sandstones are argillaceous, when a very good soil results. The trap rocks, by reason of the calcareous spar which is associated with them, often crumble into a very generous soil, and one that is durable in its constitution.

When there is a considerable amount of pebbles composed of carbonate of lime, commingled in suitable proportions with feldspathic and ferruginous-micaceous rocks, the drift soil is supplied with every inorganic element necessary to its fertility. On the other hand, when the drift is coarse, and is composed mainly of quartzose gravel, the soil has an original poverty of constitution and such porosity that heavy fertilization will have only a temporary effect upon its power of production.

The soils of the first terrace above the rivers are probably, for all purposes, the best, and on these, for the most part, the tobacco crop is grown, though some is planted on the meadow lands. These latter usually require draining, and must be protected from overflows. In some places in the Connecticut valley the soil is underlaid by a grayish clay, called "hard-pan", and when this is exposed to the atmosphere it crumbles very readily. In places it makes a spongy soil, in others a heavy clayey soil, but ill-suited for the growth of any crop except the coarse grasses.

As far as the mechanical and physical conditions are concerned, all stages, from a free pebbly mass to a retentive fine clayish soil, may be found in New England. The surface soil is in some cases deep, in others quite shallow. In the latter case, especially in the Connecticut valley, the subsoil is either hard-pan or stratified ferruginous sand deposits or gravel beds. In some localities the quartz sand is the predominating soil constituent; in others the hornblende, or the mica, or a ferruginous clay. The tobacco crop claims for its successful cultivation the best soils—well-drained, deep, mellow, clayey, or sandy loams—with a permeable subsoil. Such soil is the best protection against untimely dry or wet spells.

FOREST GROWTH.

The crests of the hills are usually covered with pines, oak, and chestnut. The hemlock (*Abies Canadensis*) is found in shaded ravines and on the rocky banks of the streams. The slopes of the hills and low plains are here and there covered with red oak (*Quercus rubra*), black oak (*Q. tinctoria*), white oak (*Q. alba*), burr oak (*Q. ilicifolia*). The sugar maple (*Acer saccharinum*) frequently occurs in groves more or less extensive. The exhausted pastures upon hills and along the slopes of the ridges are rapidly becoming covered with white birch (*Betula alba*, var. *populifolia*), in some places pines, in others junipers (*Juniperus communis—J. Virginiana*), and huckleberry (*Gaylussacia dumosa*). Upon elevated clay lands are found the ash (*Fraxinus Americana*) and the hickories (*Carya alba* and *C. porcina*). The original natural growth upon the river lands seem to be elm (*Ulmus Americana*), the pines (*Pinus strobus* and *P. rigida*), the red maple (*Acer rubrum*); in wet places the alder (*Alnus incana*), the poison sumac (*Rhus venenata*), several species of dogwood (*Cornus*), and various species of the order *Ericaceæ*, as rhododendrons, *Epigæa*, etc. The beech (*Fagus ferruginea*), the butternut (*Juglans cinerea*), and linden (*Tilia Americana*), and buttonwood (*Platanus occidentalis*) occur on some of the lower terrace lands where the soil is good.

CLIMATE.

The climate of the tobacco region of New England, though changeable, is remarkably mild and healthy for the latitude. Its severity is tempered by the proximity of the sea, and by the two large valleys, the Housatonic and the Connecticut, and the warm air from the ocean is drawn up into these channels and diffuses itself over the intermediate high lands.

At New Haven, observations extending from December 10, 1872, to October 31, 1880, show the mean temperature to be: Spring, 37°.3; summer, 71°.1; autumn, 53°; winter, 30°.8. The greatest difference between the highest and lowest thermometer in any one year was 105°; highest recorded temperature, 95°; the lowest, −14°. The mean annual precipitation, 54.01 inches; mean of prevailing winds, south.

At Springfield, Massachusetts, the observations of the signal service bureau from July 19, 1873, to October 31, 1880, show the mean temperature to be: Spring, 47°.6; summer, 71°.2; autumn, 52°.1; winter, 29°. The greatest range of the thermometer in any one year was 102°.5; the highest recorded temperature, 94°.5; the lowest, −10°. Mean annual precipatation, 47.74 inches; mean of prevailing winds, south. It will be seen that the temperature of the spring months is more than 10° lower at New Haven than at Springfield, though the latter is 48′ farther north.

LOCALITY OF TOBACCO PRODUCTION AND COMPARISON OF RECENT CROPS.

The production of tobacco in the Connecticut valley is confined for the most part to the following counties: Middlesex, Hartford, and Tolland, in the state of Connecticut; Hampden, Hampshire, and Franklin, in the state of Massachusetts; Windham, in the state of Vermont; and Cheshire and Sullivan, in the state of New Hampshire. In the Housatonic valley tobacco is cultivated in Fairfield and Litchfield counties, and to this valley belongs commercially the tobacco product of Duchess and Putnam counties, in eastern New York. New Haven county belongs in part to the Connecticut valley and in part to the Housatonic valley.

In acreage the crop of 1879 was in New Haven county 25 per cent. greater than in 1878, 20 per cent. greater than in 1877, and about equal to that of 1876. In Middlesex, Hartford, and Tolland counties the acreage for 1879 was about 5 per cent. greater than for each of the years 1878, 1877, and 1876. For the year 1879 the counties of the Housatonic valley report an increase in acreage of 10 per cent. as compared with 1878, and 5 per cent. as compared with 1877 and 1876. In Hampden county, Massachusetts, the area planted in 1879 was 5 per cent. greater than in 1878, 40 per cent. greater than in 1877, and 15 per cent. greater than in 1876. The acreage in Hampshire county, Massachusetts, has remained about the same for four years. On the other hand, there was a falling off in acreage in Cheshire county, New Hampshire, of 10 per cent. in the crop of 1879 as compared with that of 1878, the same as compared with the area of 1877, and a very great diminution, estimated at 50 per cent., as compared with the crop of 1876. In the yield per acre there was for New Haven county 10 per cent. decrease in 1879 as compared with 1878, 1877, and 1876; and Middlesex, Hartford, and Tolland show about the same. Hampden, as compared with 1877, shows 5 per cent. decrease, and with 1876, 10 per cent. decrease; Hampshire, 10 per cent. decrease as compared with 1878; Cheshire, as compared with 1878, 10 per cent. decrease, and the same rate of decrease for the years 1877 and 1876. The yield per acre in Housatonic valley in 1879 was 15 per cent. less than in 1878, and 10 per cent. less than in the years 1877 and 1876.

As to quality, the crop of 1879 in New Haven county was better than that of 1878, equal to that of 1877, and better than that of 1876. In Middlesex, Hartford, and Tolland counties the crop of 1879 was better than that of 1878 or that of 1877; and while the crop of 1876 was not so good as that of 1879, it was better than that of 1878, which was rather an inferior one. Hampden county, Massachusetts, reported the crop of 1879 as being better in every respect than those of the two years preceding, and as fully equal to the crop of 1876. The same may be said with reference to Hampshire county. On the other hand, the crop of New Hampshire in 1879 is said to be 20 per cent. worse than those of 1878 and of 1876, and equal to that of 1877. The same is true of the tobacco district in Vermont.

It may be assumed that in the tobacco-growing area of New England there has been a gradual extension of the area planted in tobacco, and the crop of 1879 shows throughout the seed-leaf district an increase of about 17 per cent. over the three years preceding, and that, compared with the crop of 1875, which was a very large one, there was a decrease.

The crop, though large in area in 1879, did not equal in yield per acre that of 1878 by 10 per cent., and the same may be said with reference to the years 1877 and 1876. The growth for the year 1878 was exceptionally large and the texture good, but a considerable portion of the crop was injured by white veins and pole-sweat. In 1879 a larger amount of Havana tobacco was grown in the counties of Massachusetts than usual, the entire crop of Seed Leaf and Havana being estimated to equal 10,000 cases, though the returns of enumerators would indicate 40 per cent. more. The crop of 1877 had a very large proportion of fine leaf, while that of 1876 was much below an average in quality. Cheshire county, New Hampshire, however, reports the crop of 1879 as 20 per cent. poorer in quality than that of 1878, about equal to that of 1877, and 10 per cent. worse than that of 1876. The crop of 1879 was good; on the whole, better than the crop of 1878, particularly the seconds, as there was not so much of it injured by white veins or pole-burn. The product of the Housatonic valley has gained popularity every year on account of its dark color.

For several years the wrappers of the Connecticut valley, though fine and silky in texture, broad in leaf, and well handled, have been too light, approaching a cinnamon color.

VARIETIES OF TOBACCO GROWN.

The several varieties of tobacco at present cultivated in Connecticut valley consist of Connecticut Seed Leaf, Connecticut Broad Leaf, Havana, Havana Seed, Belknap, and John Williams. The Connecticut Seed Leaf is broad, with small fibers, strong, thin, elastic, and silky, and the leaves are set closely upon the stalk. The best leaves of this variety are used for cigar wrappers and the poor ones for binders and fillers. The Seed Leaf is almost tasteless, and when used as wrappers for Havana fillers does not impair the flavor. The Broad Leaf is only a modification of the first, the leaves being broader in proportion to their length than the Connecticut Seed Leaf, and the fibers run out more at right angles to the midrib. The Havana Seed is grown to a considerable extent, especially in the valley counties lying within the state of Massachusetts. This variety has a very thin, fine leaf, is delicate in flavor, and yields more wrappers to the pound than any other variety planted. Grown in the Housatonic valley, this variety is noted for its fineness of texture and glossiness of leaf, which, after sweating well, has all the softness and brilliancy of a piece of silk; and as it cures a dark color, it is very popular with cigar manufacturers. It can be planted much closer than any other variety. Havana is that grown from imported seed; Havana Seed is that produced after four years. The principal objection to this variety is made by the farmers, who assert that, though the price is greater per pound than for the Seed Leaf, the small yield per acre does not make the crop so profitable, especially in those counties well adapted to the growth of the latter. This, no doubt, is the reason why Havana Seed Leaf is grown in larger proportions in the upper counties of the valley than in the lower ones. In the lower counties the soils produce a wrapping leaf unequaled in fineness by any other grown on the continent.

The Havana is grown to some extent in the upper part of the Housatonic valley for fillers. In answer to a letter addressed to him on the subject, Mr. Perry N. Hall, of New Milford, Connecticut, says of the Havana Seed:

> It is more generally known in market quotations as Connecticut Havana, and is produced in this way: Seed from the Vuelta Abajo district in Cuba is sown here three successive seasons, and the seed from the third and fourth years is laid up for future field cultivation. It is preferred, as being more leafy than other kinds of Cuba tobacco. The first year it grows small, producing little if any wrapper leaf, but makes a filler for cigars which retains some flavor. It is not used to any extent in field cultivation until the third or fourth year. It will retain its distinctive peculiarities for many years, provided the seed can be grown so as to entirely prevent its mixing with the Connecticut seed tobacco. As this is very difficult, on account of bees carrying the pollen from one plant to another, the plan of laying up and keeping the seed for a number of years is practiced. This tobacco produces fewer pounds per acre than the Connecticut Seed Leaf, but brings a somewhat larger price. It generally sweats to dark colors, and is easily cultivated and harvested.

The largest variety grown is said to be the Barber, a variety produced by making a careful selection of the earliest plants and carefully trimming the seed stalk of all late blooms. This variety is remarkable for the great size of its leaves, the smoothness of its texture, and the uniformity of its color, and it is highly esteemed for making wrappers. The Podunk has upright leaves, thickly disposed upon the stalk. Another variety of Seed Leaf, called Duck Island, is grown to a considerable extent in the Housatonic valley. It is medium in size, and very fine in texture and fiber. The other varieties mentioned are subvarieties of the Seed Leaf, and are distinguished from it only in the shape of the leaves, and not in the flavor, habits of growth, or uses.

The quality of these different varieties is greatly affected by the character of the soils upon which they grow. Where the soil is a heavy clay loam, the tobacco grows with more thickness of leaf, and has more gum in its tissues, cures a darker color, and will bear sweating better, but is not so well suited for wrappers, because of its comparative coarseness of texture. Upon light sandy soil the quality is very fine, but the color is light. By judicious sweating, tobacco can often be changed from a light cinnamon to a dark brown color, in which case it makes wrappers that command the highest prices. A quality of tobacco between the two is very popular, because it both sweats well and supplies a large proportion of wrappers.

Soils near the sea-coast, though in appearance having all the physical qualities required for the production of the finest leaf, yet often produce tobacco the burning qualities of which are imperfect. This doubtless arises from the existence of the chloride of sodium, or common salt, in the soil; for it is the result of long observation, both in Europe and in this country, that the use of salt, while it is thought to increase the crop, diminishes the burning qualities of tobacco. The soil preferred in the Housatonic valley is known as a ridgy loam, dark in color, with a small portion of sand. It is intermediate between a light sandy and a loamy clay soil, and is found on hill lands. The tobacco grown on this soil has all the fineness of texture of that grown upon a light sandy soil, and most of the body, and all the elasticity, strength, and sweating qualities, of that grown upon a clayey soil, and will supply more wrappers than if grown on either the light sandy or the heavy clay soils.

Of the tobacco raised in New England, the best crops will make 66 per cent. wrappers, 25 per cent. seconds or binders, and 9 per cent. fillers; but the inferior crops will show a reduced percentage in wrappers, and a corresponding increase in the other two grades.

It is the impression among many dealers and farmers that the quality of the tobacco has deteriorated during the past decade, but of this there is some doubt. Many maintain, with a good show of reason, that the crop is much better managed now than ever before, because buyers exercise more vigilance in the selection of good crops than formerly, and because the houses in which it is cured are better fitted for the purpose. There is a small area, about fifteen miles long and three miles broad, in which are included South Windsor, East Hartford, and Glastonbury, that is pre-eminently distinguished for its fine leaf. The soil is a light yellowish sandy loam, very mellow, made very fertile by the application of manures, moist and warm, and usually deep, but occasionally sandstones of the Triassic period appear above the surface, these sandstones being ferruginous, sometimes micaceous, and often conglomeritic. The fineness of the sedimentary deposits, the variety of the inorganic elements derived from the slates, traps, granitic, feldspathic, and hornblendic rocks that bound the valley, and the excellent drainage, all combine to make a soil perfectly adapted to the growth of the tobacco-plant. For the growing of tobacco a very small percentage of the land is employed; indeed, in a farm of one hundred acres, three or four acres may be considered the average amount planted.

ROTATION.

In the Connecticut valley all the soils cultivated in tobacco have been in careful and skillful tillage from one hundred to two hundred years or more. The rotation practiced in the valley is grass several years, after which succeeds tobacco for a number of years, two or three usually, but frequently four or five, after which the land is again seeded to grass. It is difficult to have any regular rotation, because the local variations in soil characteristics make some of it peculiarly adapted to the growth of tobacco, while other varieties are better suited to the production of hay, or corn, or buckwheat, or are found more profitable in permanent pasturage.

Grown upon rolling lands of the Housatonic valley, tobacco has a much darker and thicker leaf; but upon freshly-cleared lands it grows coarse, and is destitute of gum and elasticity. Probably one-third of the crop grown in this valley is planted on valley lands and the remainder on slopes and tops of ridges.

MANURES AND THEIR APPLICATION.

The original growth of the tobacco area is said to have been white oak, pine, red maple, birch, and chestnut, which would indicate soils of medium strength. In the raising of a tobacco crop especially manures always enter as much into the calculation of the cost of production as the labor employed, from five to ten loads of stable manure being applied to every acre intended for tobacco, and generally from 300 to 500 pounds of superphosphates or Peruvian guano. In the districts around Hartford the following are the kinds and the prices of the various fertilizers, as well as the amount used per acre:

Kinds.	Cost.	Amount applied per acre.
Stable manure	$6 to $8 per cord	5 to 15 cords.
Castor pomace	$22 per ton	When used exclusively, 2 tons; less quantity with other fertilizers.
Peruvian guano	$56 per ton	300 pounds, in connection with 5 cords of stable manure.
Superphosphates	$30 to $40 per ton	300 to 500 pounds, with from 5 to 9 cords of stable manure.
Bone meal	$32 to $40 per ton	Always used with other fertilizers; not a favorite with tobacco-growers.
Fish guano or scrap	Dry $35 to $38; half dry $18 to $20 per ton.	From 1,000 to 2,000 pounds per acre, always applied with other fertilizers, not a favorite manure.
Tobacco stalks	$10 to $14 per ton	When applied exclusively, from 1½ to 4 tons.
Lime	$1 50 to $2 per barrel of three bushels	Two barrels, with other fertilizers.
Leached ashes	26 cents per bushel	Very popular with tobacco-growers; quantity applied very variable.
Newton marl	$3 to $8 per ton	Two tons; said to make tobacco of superior quality.
Stockbridge tobacco fertilizer		Used by some with good results; 500 pounds per acre.
Sheep manure	$8 to $10 per cord	All that can be obtained.

I. F. C. Allis, of East Whately, Massachusetts, in a letter to John L. Hayes, secretary of the National Board of Wool Manufacturers, says:

The cause for feeding so many sheep for their mutton in this valley is the high value of sheep manure for tobacco-growing, it having the effect on our light soil to produce a dark-colored silky leaf, of good burning quality, suitable for wrapping fine cigars. This tobacco burns white, and has a good sweet flavor, perhaps owing to the potash it derives from the manure. So valuable do we consider this sheep manure, that we have shipped, since 1870, from West Albany, from 50 to 60 cords, costing from $8 to $10 a cord, every spring. On our light soils, called pine lands, after raising crops of tobacco, 2,000 pounds to the acre, we have sown wheat, yielding 30 bushels, plump berry and heavy weight of straw, on land which, without this dressing of manure, is fit only for white beans. We of late years feed with our sweetest and finest hay, and mix with our corn one-third cottonseed meal. By so feeding, our sheep fatten more easily, being more hardy and better conditioned, beside increasing the value of the manure and rendering it more full of plant food.

There is a considerable contrariety of views expressed respecting the effects produced upon the quality of the tobacco by the application of the several fertilizers mentioned. In some of the schedules returned to this office from intelligent growers it is strongly stated that heavy manuring is not only necessary to grow heavy crops, but that in the heaviest crops is found the largest proportion of excellent leaf. Others claim that heavy fertilization, while it adds unquestionably to the quantity produced, yet affects the quality injuriously as to texture, strength, and silkiness. These contradictory statements can only be reconciled by the hypothesis that the soils in either case are radically different in chemical constitution. Says one schedule: "Fish guano makes tobacco heavy, rough, and scaly, with bad burning qualities." Others claim that fish-scrap is an excellent manure. The first statement accords fully with that made by Professor Johnson as to the widespread prejudice existing among tobacco-growers to the use of fish or fish guano on tobacco fields. Of the beneficial effects of Peruvian guano on tobacco soils there is no discordance of views.

In the Housatonic valley the land, whether sod or cultivated in a previous crop of tobacco, is treated to a heavy application of stable manure, running as high as thirty or forty cart-loads to the acre, at a cost of from $50 to $60. Cow-dung is said to have the best effect upon color, horse-dung, though making a good quality of tobacco, inducing lighter colors. Saltpeter also is applied to improve the quality. All fertilizers, except special manures, are spread broadcast over the land, and are plowed or harrowed in; and without their use it would be considered folly to plant a crop of tobacco, as the small size of the leaf and the deficiency in gum and other qualities would make the crop exceedingly unprofitable.

In Fairfield county the yield per acre has decreased considerably, but no cause for such decrease is assigned.

In Litchfield county the yield has slightly increased, owing to better cultivation than formerly and higher manuring. One fact in connection with tobacco culture in this county is significant: the tobacco lands have been enriched at the expense of the corn and grass lands, for all the manure made upon the farm is reserved for the tobacco crop. The hay, corn, and other crops have sadly fallen off in yield, and it is a mooted question whether, on the whole, the county has been benefited in an agricultural point of view by the production of tobacco. The breeding of cattle and sheep, the making of hay and butter, and the growing of wheat and oats, have all declined since tobacco has become a staple; and, though there is more money handled by the farmers than formerly, the farms are not generally kept up to such a high state of cultivation.

It may be remarked, however, in this connection, that the making and saving of manure all through New England is considered one of the most important operations of the farm. Barns are constructed with cellars, in which muck is spread, to collect and preserve the urine of the animals which feed above, and into this cellar are thrown all the droppings of horses and cows, which are worked over again and again by the swine that are permitted free access to the cellars. It being found impossible to make a sufficiency of manure for all the requirements of the farm, it is often imported from New York city at a cost varying from $10 to $15 the cord, a cord weighing about 4,500 pounds. Artificial fertilizers are largely used on the tobacco crop, more with a view of giving it an early start than as a safe reliance for carrying it to maturity. Peruvian guano is applied, as also the superphosphates, in connection with stable manure, which act as a stimulant to the tobacco-plant in its early growth, until its dense roots are able to reach out in tufted masses and appropriate the coarser material of stable and other barn-yard manures.

SEED-BEDS.

Burning as a preparation is rarely practiced, and then only for the purpose of destroying the seeds of weeds and grasses. The methods of growing tobacco-plants are like those given in Chapter XX of this report.

PREPARATION OF THE SOIL FOR TOBACCO.

The soil intended for tobacco is rarely broken in the fall, unless it is a heavy clay loam, which needs the ameliorating effects of freezing to make it crumble well. Upon sandy loams the work of preparation begins in the spring. The land receives a heavy coating of barn-yard manure, and is plowed with a turning-plow to the depth of from 7 to 12 inches. It is cross-plowed in May, harrowed, and smoothed. With a "ridger" beds are thrown up from 36 to 42 inches apart and 6 inches high. These are smoothed off at the top, and with a wheel prepared for the purpose are marked for planting at such distances as may be determined upon, these distances varying from 20 to 24 inches, and sometimes, but not always, hills are made at the points marked on the ridge for the plants. The longer distances given are for Connecticut Seed Leaf, the shorter ones for Havana Seed. When it is desired to supplement the application of stable manure with stimulating fertilizers the land is furrowed out 3 or 3½ feet apart and 300 pounds of guano or 500 pounds of superphosphates are strewn in the furrow. On this two other furrows are thrown, to make a bed, which, after being smoothed off, is marked for hills. The guano or superphosphates are sometimes sown broadcast over the land and harrowed in before it is marked off. The effect of fertilizers upon the crop is tersely expressed in one schedule as the "difference between a crop and no crop".

Dr. Riggs gives an account in the report of the Connecticut board of agriculture for 1871 in reference to the preparation of soil for his tobacco crop. After the tobacco is cut and housed in the fall the land is plowed lightly, and 1½ bushels of rye are sown to the acre. This gets a good start before winter, and in the spring, when he wishes to plow for tobacco, it is 4 or 5 inches high. He then takes what he calls a "smoothing-iron", 4 feet square, made with 2-inch plank, spiked with railroad spikes to joists 3 by 4 inches, the front end and sides of the implement beveled so as not to carry the earth along with it. Two or three weeks before planting this is drawn over the rye to level it. The soil is fertilized with 300 pounds of guano, which, with the rye, is turned under to the depth of 12 inches. In this condition the land lies until it is nearly time to prepare it for the plants, when he applies about one-third of the quantity of barn-yard manure that would have been put on but for the rye and guano. This manure, with 400 pounds of additional guano, is spread over the land and harrowed in thoroughly. The "smoothing-iron" is then used until the whole field is as smooth as a floor. The land lies in this condition for a few days, until the guano and manure have become absorbed and incorporated into the soil; then the field is marked off into rows, and two furrows are thrown on each mark, making ridges which are 3½ feet apart. Hills are made on the ridges from 22 to 24 inches apart, and are planted after a shower of rain with plants the leaves of which are as large as the palm of the hand. The yield of his crop varied from 2,200 to 2,400 pounds per acre, although he applied two-thirds less stable manure than he would have done but for the rye which he plowed under.

In New Haven county, and probably in other counties, the rows for Connecticut Seed Leaf are sometimes made 4 feet apart, while the plants are set out 2 to 2½ feet in the row, the greater width being rendered necessary in seasons of vigorous growth to prevent breaking the leaves in passing through to destroy the worms and to pull off the suckers. It is also believed that wide spaces are favorable to a more thorough development of the leaves, air and light being necessary to insure a uniform growth and a uniform ripening of all the leaves.

The small area planted in tobacco by each farmer in New England enables him to plant his crop whenever the plants are large enough to transplant. This is done from the 1st to the 20th of June, sometimes earlier, whether timely rains make the ground moist or drying winds exhaust the moisture. In the former case, the plants are set rapidly; in the latter, every hill is moistened by artificial means, and each plant is protected from the scorching rays of the sun at midday by tufts of grass or in some other manner. It is considered very important to get a good "stand" at first planting, so that all the plants may grow evenly; otherwise the fields have a ragged look, some plants being small, while others tower above them. The topping and cutting are also made irregular, the first plants requiring to be topped and cut several days or weeks before those replanted, and in some years fully 25 per cent. of the first planting is cut off and destroyed by cut-worms. The younger or replanted stalks are often topped to a less number of leaves, in order that they may ripen with the first; but in this case there is a disparity in growth, and often a deterioration in the quality. Under very favorable circumstances the transplanting may be continued until July 4. After the plants have been in their places four or five days they begin to grow, when the earth should be loosened about them and the surface of the ground kept soft and fine. At least three plowings and as many hoeings are given the plants before they are ready to be topped, which is within from forty-five to fifty days after they are transplanted.

TOPPING, PRIMING, SUCKERING, AND WORMING TOBACCO.

In reference to topping there is the usual diversity of views. All, however, agree that the plants should be topped as soon as the flower buds generally appear over the field. If the soil has been well pulverized, the blossom bud will not show itself until the plant has developed a large number of leaves; but in dry weather it appears when the plant has comparatively few leaves. In topping on rich soils, from twelve to sixteen leaves are left on each plant, and on the Havana Seed variety a much larger number of leaves is left, sometimes as many as twenty or twenty-five; but on thin soils, or on soils not well manured, in very dry weather, only ten or twelve leaves are left on each plant. It is the experience of all good planters that a larger proportion of good wrappers is obtained by topping low, so that every leaf may become of a uniform size. When too many leaves are left to the stalk the top leaves rarely ever attain their full growth, and all will be deficient in gum and elasticity. No priming is done. Dr. Riggs maintains that "priming", or pulling off a few lower leaves, is a great advantage to the plant. The lower leaves are always classed with the inferior grades, being generally ragged, earth-burned, worm-eaten, and bespattered with dirt or sand. Beside, their presence on the stalk prevents the working of the soil near the plant, which is necessary to obtain the best results. Dr. Riggs' practice, which is a very successful one in results, is to top down to a good healthy leaf, and to top low enough so that the top leaves will attain an equal size with the best of the others. From eight to ten leaves in the most fertile fields, and less in a crop that does not grow so heavily, is the rule of guidance which he lays down. Nevertheless, but few planters adopt this suggestion, and the general average is from twelve to sixteen leaves for Connecticut Seed Leaf, and from sixteen to twenty-four for Havana tobacco. The suckers are pulled off as they appear, the best growers rarely permitting them to attain a length of 4 inches. This operation is performed generally twice before cutting, first a week after the plant is topped, and again just before it is cut. A few pull off the suckers once only. The work of destroying the worms is done every day, if possible, as no tobacco is so much injured in quality by worm holes as the cigar wrapper. The moths are caught or beaten down with a wisp of fine brush at evening. A few farmers plow their land in the fall, in the belief that by exposing the worms in their chrysalis state to the frosts of winter they will be killed. The worms are destroyed by hand-picking, and sometimes, but not often, by gangs of turkeys.

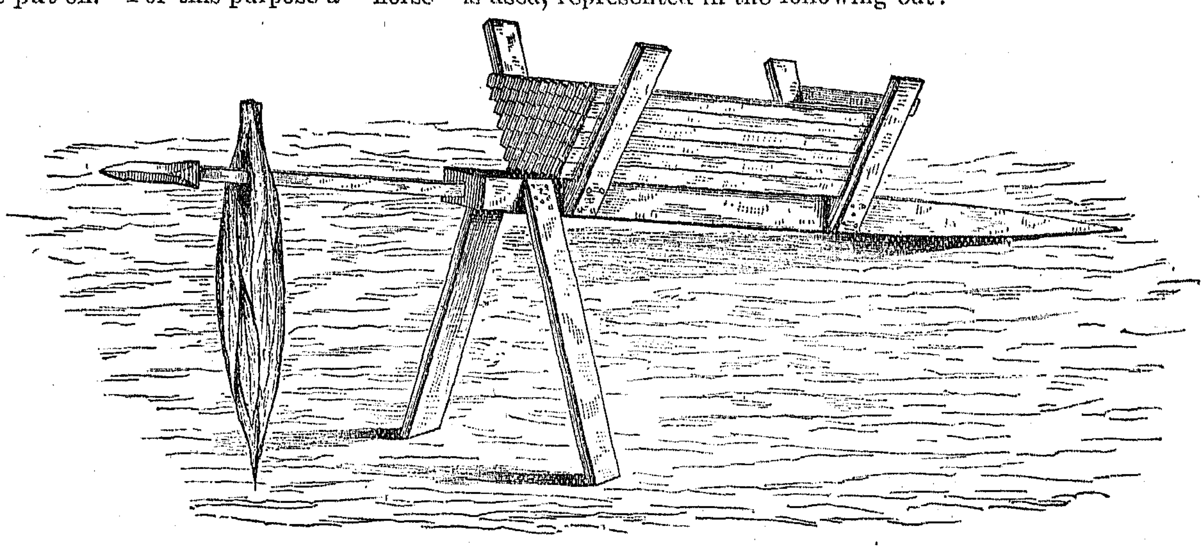
After the Connecticut Seed Leaf has been topped from two to three weeks, by a careful inspection of the top surface of the leaf irregular yellow spots, shading off into the general green of the leaf, will be seen. A grainy appearance also becomes visible on the surface, and the leaf becomes somewhat crisp, and will break by doubling. Though not fully ripe, it is in the proper condition to make leaves best suited for wrappers, and to permit it to remain longer in the field would thicken them. Rains at this period injure the leaf by washing away the resinous substances that give it a satin-like face after it is cured and sweated. Heavy dews and cool nights are favorable for the development of these resinous compounds.

When the Connecticut Seed Leaf was first grown in the Connecticut valley it was the custom among farmers to let it ripen fully; but experience has taught them that its highest perfection is reached about the time the upper leaves attain their full size. In other words, the time most propitious for cutting tobacco is when the process of expansion ceases and that of granulation fairly begins. This is not the case, however, with the Havana Seed; for unless this variety is permitted to remain until the sweet gums are secreted the aroma for which it is prized and its glossiness will be lacking, and it will not occupy no higher standard than a small, thin, wrapping leaf, unequal in size and inferior to the Connecticut Seed Leaf. On this account it is allowed to stand for three or four weeks after being topped.

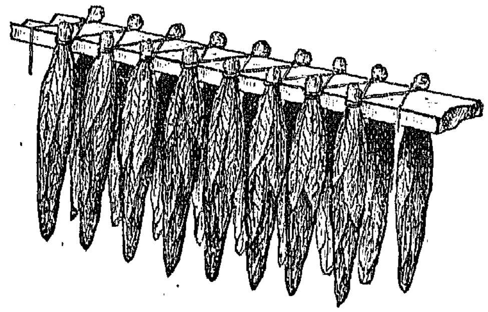
CUTTING AND CURING OF TOBACCO.

The cutting of tobacco usually begins in the second week of August, and continues through that month and often as late as the 10th of September. When planted upon warm, sandy soils, tobacco will mature from one to two weeks earlier than when planted on a clayey loam. While the latter will not mature so rapidly, it has more body and will cure up darker in color—a thing very much desired by the tobacco planters for two or three years past. The time selected for cutting is when the dew is off the leaf and the sun not too hot, from three to six o'clock in the afternoon being considered the best time. If cut when the dew is on, it breaks more easily, and dirt will adhere to the surface of the leaves that come in contact with the ground. A sunburned leaf, it may be well to add, is one whose juices have been dried out, in whole or in part, by the heat of the sun. Although perfectly green in color, it will crumble to the touch, and though it may become pliant, the green of the leaf never disappears if put in the shed. One method only will remedy in part this evil, and that is to let the sunburned plant take the dews for several successive nights.

The instrument employed for cutting is a hatchet, a hay-knife, or a saw, the latter being preferred, because, like the hatchet, it does not jar the plant. The plants are grasped about the center of the stalk with the left hand, and with the saw, hatchet, or knife in the right hand they are severed within an inch or two of the surface and laid back upon the row, and, after they are somewhat wilted, are taken by other hands and speared about 6 inches from the butt on a lath. From four to six plants are put upon each lath, unless they are very small, when a larger number may be put on. For this purpose a "horse" is used, represented in the following cut:

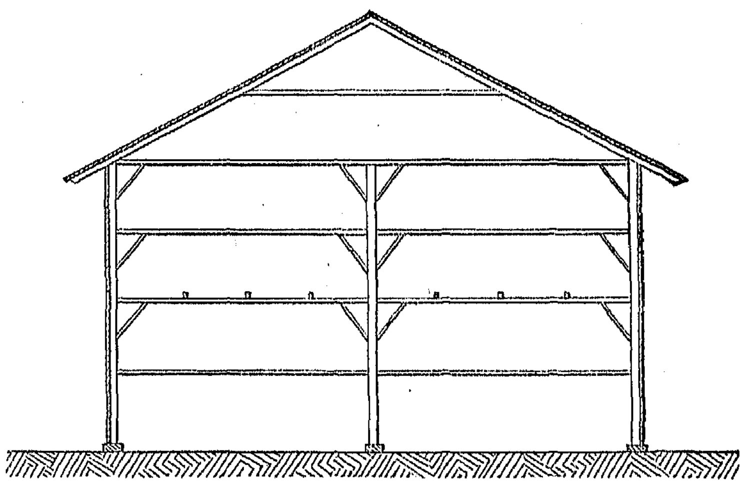


The spear has a socket, by which it can be fastened to the lath; and as fast as the laths are filled they are hung upon a frame on a wagon and are hauled to the curing shed, or, as is the practice with many, are put upon scaffolds in the fields, constructed with carpenters' trestles, as shown in the illustration. If taken to the sheds at once, the doors are left open until the tobacco is thoroughly wilted and the leaves hang perpendicularly. Before the laths are put in place on the tiers in the shed the plants are carefully arranged on them, giving to each plant an equal amount of space. These are then put upon the tiers, 6 or 8 inches apart, filling the top tiers of the shed first, and working downward until the whole shed is filled. The tobacco is carried to the barn on wagons having a frame nearly 4 feet wide, or just wide enough to catch the ends of the laths, and high enough so that when a stick of tobacco is hung on the frame the tails may not touch the bottom of the wagon bed. These laths are $1\frac{1}{4}$ inches wide and five-eighths of an inch thick. It was a practice, pretty generally followed in the Connecticut valley a few years ago, to tie the plants to poles with twine, these poles being 12 feet long. The plants were tied on alternate sides, from 9 to 12 inches apart on a side, making from twenty-four to thirty-two to the pole, as illustrated.



Some few farmers still adhere to this method of housing, and discard the lath and spear altogether. While it may require a little more time to harvest tobacco in this way, it is asserted that the number of leaves damaged is not so great. It is also said that the amount of tobacco injured from pole-sweat is less, as each plant, when tied to the pole, has its distance distinctly marked, and, as the poles are put from a foot to 15 inches apart, currents of air can circulate more freely between them. Hanging in this manner, however, is a very tedious process, and though it may have some advantages over the spear and lath system, the greater care and the longer time demanded, at a period when time is most valuable to the tobacco-grower, has to a considerable extent brought it into disuse.

The character of the sheds or barns has been very greatly improved within the last decade. For a long time tobacco-growers utilized the stock barns, cattle-sheds, and other outhouses for curing tobacco; but much of it was injured by winds and undue exposure in damp, rainy weather, and in other ways. Judicious economy suggested the building of houses for the curing and handling of the crop, the usual size of these houses being 24 feet wide, from three to four tiers high, and as long as the necessities of the crop might demand. To hang an acre of tobacco requires a house 24 feet wide, 30 feet long, and three tiers high, or the same width, 24 feet long, and four tiers high. It is easy to estimate from this the length of the building required to house a crop of tobacco. The distance between tiers varies from 4 to 5 feet.



Havana Seed tobacco may be safely housed, with tiers $3\frac{1}{2}$ feet apart, in perpendicular distance. There are two ways of constructing these sheds, one by a series of bents placed 12 feet apart. The accompanying illustration will show the manner in which these bents are constructed.

The posts rest upon low rock pillars, in place of sills, and the lower girders are movable, so that they may be taken out for the passage of a wagon.

A few barns are constructed 36 feet in width; but they are objectionable, from the fact that the middle range is not so well ventilated, and there is greater danger of pole-burn.

Many sheds are two or three hundred feet long, the length being always regulated by the size of the crop.

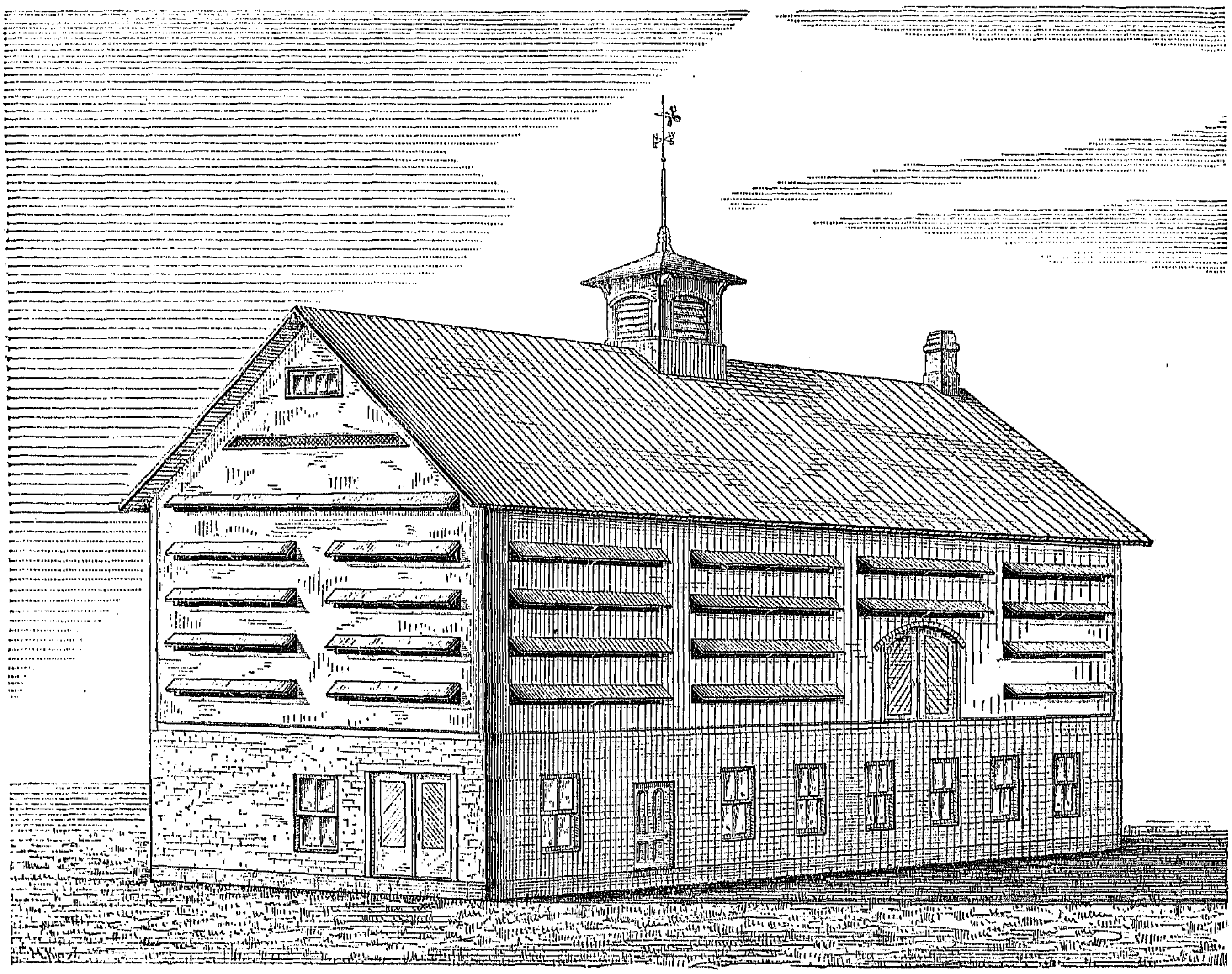
The poles upon which the tobacco is hung are put from bent to bent. If the tobacco is tied to the poles, a greater number will be required; but if laths are used, seven poles only are necessary between each two girders connecting the posts in a shed 24 feet wide, the lateral girders connecting the bents supplying two others.

The other method of constructing sheds is to frame two or three girders, according to height, into the posts on all sides of the building, the first 5 feet above the ground, the second $9\frac{1}{2}$ feet, and the third 14 feet, the latter on the sides being used also to support the rafters. This gives a space of $4\frac{1}{2}$ feet for each tier, but this distance should probably be increased to 5 feet for very long tobacco. Upon a line of posts along the center of the building, parallel with and 12 feet from the sides, are framed girders, corresponding with those on the sides, for the poles, 12 feet in length, to rest upon, one end on these, and the other on the corresponding girders on the sides. Ventilators are put upon the top of the roof. Better results are said to be obtained by having a monitor roof extending the whole length of the building.

In the case of a monitor roof, the building is raised a foot or more above the ground, and drop-doors are made for the openings below and for the monitor roof above. When these are opened a constant draught of air passes from bottom to top, and the tobacco is cured with a much smaller proportion of house-burn than when perpendicular air-openings are provided.

Cellars to the best sheds are now prepared to be used as stripping-rooms and for bringing and retaining the tobacco in proper condition. Sheds which have recently been erected cost from $300 to $1,000; sticks, $3 per thousand.

The following is the elevation of a model barn or shed for tobacco, erected by G. W. Mitchell, of South Britain, Connecticut. This barn is 60 feet long, 32 feet wide, and 27 feet in height, and holds six tiers of tobacco, beside a small tier in the ridge of the building:



CURING TOBACCO.

The dampness arising from the ground is supposed to exercise a beneficial influence in the curing process, and for this reason many prefer sheds with dirt floors. At every three or four feet vertical doors are made in the sides of the sheds, and these are opened or shut, as the necessities of the tobacco require. The rule governing this matter is that the tobacco shall become damp at least once a week. If the weather is very moist, the doors are closed to prevent pole-sweating; if it is very dry, so as to cure the tobacco too rapidly, the doors are closed and the floors dampened. The periodical dampenings cause the juices to permeate the leaf and insure a uniform color; but if subjected to too much moisture, there is a tendency to mold, and the texture of the leaf is impaired by the excessive absorption of water, which, when it evaporates, carries away the oils that give it softness and silkiness. The most difficult problem in wet weather is how to prevent injury from these sources without the use of fire, the practice being to close the sheds securely and keep out as much moisture as possible.

G. W. Mitchell, of New Haven county, says in relation to the ventilation and curing of tobacco:

The openings should be made at the top of each tier of tobacco horizontally, instead of perpendicularly, as the old style is. The usual method has been to put a pair of strap-hinges at the top of the door, one foot wide, and open at the lower end; but a much better plan is to have the doors open lengthwise of the building, so that the air will pass through between the tiers of tobacco. They should also open at the bottom and have a ventilation at the top, so as to have a circulation from bottom to top. The building should be so constructed as to be shut up tight in very dry or windy weather. Give plenty of air for two or three weeks after it is first housed, then let it cure slowly by closing the doors during the day and opening them at night, so that the tobacco may receive moisture. This will give a uniform color.

Some prefer to keep doors open day and night for two weeks after hanging, that the dampness of the night may better equalize the dryness from day opening only.

The course pursued in curing has been changed to a considerable degree during the past three or four years. When light wrappers were in demand the doors of the sheds were thrown open during the day and closed at night, but since dark wrappers have come into fashion the doors are opened at night and shut during the heat of the day; for it is a generally accepted opinion that light and heat, by accelerating the process, make a leaf light in color. Peruvian guano is thought to favor the making of dark colors, and has been extensively employed in the production of the crop, and gypsum, sprinkled on the plant while growing, will darken the colors. Tobacco, when thick, always cures up a darker color. Thin leaves, very fine and delicate, are always inclined to cure up light colors, and require from ten to twelve weeks for the tobacco to cure fully. The existence of white veins in the leaf occurs under circumstances sometimes seemingly opposite. By some they are believed to be caused by long continued dry weather before and after cutting; by others, as due to any check in the growth of the plant, whether from lack of manure, or cultivation, or drought, or too much water; and some think they are caused by the lack of some organic or inorganic substance in the soil. All that can be said with certainty is that they do occur, very much to the injury of the leaf for wrapping purposes. As a general rule, the product from a field well prepared, well fertilized, and well cultivated, planted in good season, the plants properly topped and kept free of suckers, will show, when cured, very few white stems.

POLE-SWEAT.

Damage from pole-sweat during a favorable season for curing is very small; but the years 1872 and 1878 are memorable among the tobacco-growers of New England from the large amount of tobacco injured in this way. The weather throughout the curing season of those years was damp and foggy, and the buildings, as a general thing, were not constructed so as to have the tobacco under control. The consequence was that a large proportion of the crop was lost, or was so badly damaged that the price was greatly reduced.

The best protection against pole-sweat in wet weather is tight sheds and plenty of room, frequent airing during dry weather, and the sheds closed tightly during long seasons of wet weather. In the Seed Leaf district pole-sweated leaves are thrown away or are used as a fertilizer.

ASSORTING, HANDLING, AND PREPARING TOBACCO FOR MARKET.

When the leaves and stalks are completely cured, so that no green is visible, the tobacco is taken from the laths, and the leaves are stripped off and are either tied into hands of 12 to 20 leaves or bound with twine into bundles weighing from 10 to 40 pounds. In this condition it is delivered to dealers, who pay a certain price agreed upon for the crop through.

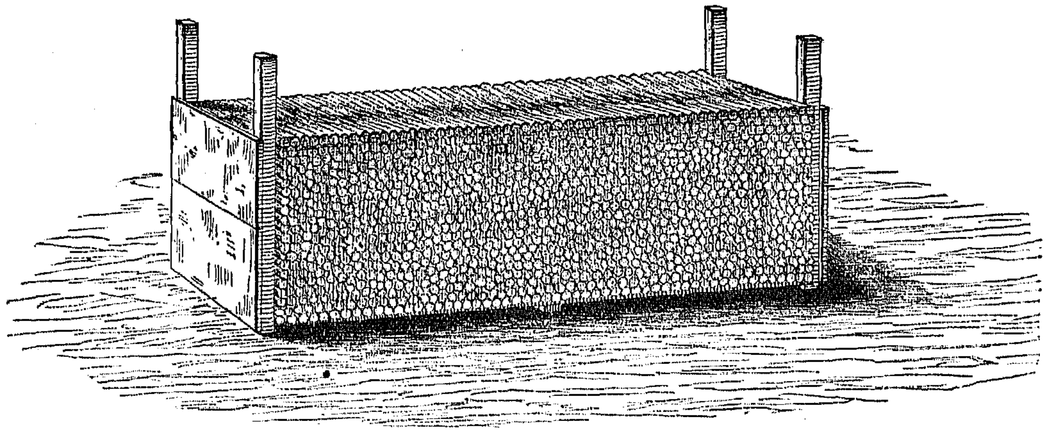
Dark tobacco, made so in the curing process, will command, crop through, from 3 to 5 cents per pound more than crops of light color, though the latter may have the same texture, fiber, and length. Local dealers, who buy direct from the farmers, carefully assort the tobacco, classify it, pack, sweat, and sell it to jobbers.

The quality of the crop is determined by the wrappers. If the proportion of wrappers as compared with other grades is large, the price will be correspondingly high, the quality, size, texture, and color of the wrapper determining its price. A large, coarse wrapper is not so desirable as a smaller, but fine one; nor is a fine wrapper of bad color prized as highly as one coarse in texture but of a uniform color. The best wrappers are characterized by fineness of fiber, largeness of leaf, uniformity of color, and a satin finish, are free from white veins, and have an elasticity and strength of leaf sufficient to bear the tension required in wrapping cigars; the seconds are leaves slightly injured, but may be used for the inside wrappers of cigars. Mutilated, worm-eaten, and pole-sweated leaves, and those injured by fat stems, are used for fillers. In a good crop, well cured, there will be about the following proportion of each grade: Wrappers, 60 per cent.; seconds, 28 per cent.; fillers, 12 per cent.

The proportion of long and short wrappers is variable. If the crop is planted at the same time upon land of uniform fertility, there will be only one grade of wrappers; when, however, the crop is planted at different times, or upon soils of unequal fertility, the wrappers are put into two grades. At the time of assorting, the tobacco, unless already tied into hands by the farmers, is made into bundles of from 18 to 24 leaves each and bulked down in two courses, the heads being turned outward and the tails overlapping about 6 inches in the middle, the idea being to expose the heads so that they can dry out. The ends of the bulk are usually protected by boards nailed to upright pieces, as represented in the diagram on page 254. Bulks are made on a temporary platform raised a few inches above the ground, so that the air can circulate under them, are 4 to 5 feet wide, and of any length desired, the layers of tobacco alternating on each side, and are built up to any height desired, usually, however, about 4 feet. Two bundles are laid down, one at a time, heads out, until a course is run on one side of the platform. A similar course is run on the other side, the tails lapping from 4 to 6 inches, to equalize the height in the middle of the bulk. When bulked, the tobacco is in a moist and pliant condition. The completed bulk is covered with blankets and weighted down for a few days, when it is ready to be packed in boxes.

A cord of rich tobacco, well packed and weighted, will make a ton. Sometimes the planter, when he desires to put the tobacco in casks, assorts and ties up in hands of suitable size as fast as the leaves are picked from the stalk, the inferior or filler leaves being taken off first, the binders next, and lastly the wrappers.

Dealers examine the crop very thoroughly before buying, and even when it is growing agents ride from farm to farm to examine the crops in the fields, the culture, size, amount of worm-eaten, rust, regularity or irregularity of the crops being all noted. When the crops are housed, these agents visit the sheds to see that there is no pole-sweated, wind-shaken, or weather-beaten tobacco, and also to examine the uniformity or diversity of the color; and

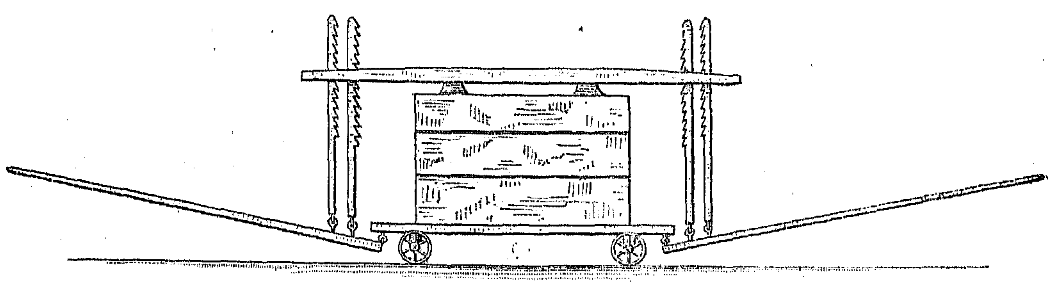


after the leaves are picked from the stalks there is frequently another examination, to note its condition, so that by the time the crops are ready for market the dealers are as familiar with their quality as the farmers themselves. This vigilance on the part of dealers has had a good effect in stimulating planters to handle their crops with greater care.

It is exceedingly important to have the tobacco in a proper degree of pliability when it is packed; for if too dry, great damage is done to the leaves by breakage. The best wrappers may be reduced to the grade of fillers by handling when dry. On the other hand, too much humidity in the leaf will produce a fermentation so excessive as to destroy the vitality of the tobacco and induce a mold, which imparts to it a disagreeable odor. Good judgment is required in this stage. If bulked in very cold weather, the amount of humidity in the leaf is often greatly underestimated, and if warm weather supervenes will endanger the tobacco. The plan adopted by the best managers is to see first that the stems or midribs are fully cured; that they do not hold a disproportionate amount of moisture as compared with the leaf. Should the leafy part be very dry and the stem very moist, there is more danger of injury from excessive fermentation than if the conditions of the leaf and midrib were reversed. The proper condition is to have the leaf soft and pliant, and the midrib just sufficiently moist to handle without breaking.

The usual date of delivering tobacco to dealers is from December 1 to April. A very small proportion of the crop is now packed by the planters, and damp days, or at least days in which drying winds do not prevail, are selected for delivering the crop.

For wrappers, the boxes are 3 feet 8 inches long and 28 inches square at the head; for seconds, 3 feet 3 inches long and the same size at the head as for wrappers; for fillers, 3 feet long and 28 inches at the head. These boxes are made of white pine. Boxes for wrappers cost $1 25; for seconds, $1 20; for fillers, $1 10 each. In these boxes the tobacco is packed with heads resting against the ends. The quantity of each grade packed in a box is:



wrappers, 400 pounds; seconds, 350 pounds; fillers, 300 pounds; and it requires some pressure on the tobacco to get the quantity mentioned in the boxes. This pressure is generally applied by a double-lever press with a platform resting upon wheels, so that it can be readily moved to different parts of the building. A yoke crosses the case and works in racks, two on a side, which are attached to the levers. The accompanying cut will give a good idea of this simple press.

About 200 pounds are first packed in a box and pressed down; then the box is again filled and pressed, and this is continued until the requisite number of pounds have been put in each box.

SWEATING TOBACCO.

After being properly packed, the tobacco is ready to go into the "sweat", or fermentation, which begins as the weather grows warm and continues for many weeks, and during this period the tobacco becomes warm, reaching a temperature of 100° F., and sometimes more. All cases are marked with the weight, quality, the name of grower, etc. During the process of sweating the boxes are piled on one another, generally on their sides, but are never exposed to the rays of the sun. A well-plastered or ceiled room is prepared for this purpose, the heat generated being at times so great in the sweating rooms as seriously to affect plastered walls. The process of sweating is to tobacco what fermentation is to wine. It ripens it and prepares it for use. It perfects it in color, improves the flavor, subdues the acrid or pungent taste, increases its burning qualities, and gives it a shining, oily surface, which is called "satin face". All tobacco, however, does not go through this process well, as all wines do not ferment well. Some of it comes out with a lifeless appearance. Whether this is due to the want of essential oils, or arises from the improper condition in which it is packed, is a question not fully determined. Tobacco, like wine, will often go through a second fermentation the ensuing year with an improvement of quality. No artificial means further than "spraying" are used for "ordering" the tobacco before packing. The amount injured by oversweating is small, and will not exceed 1 per cent. The greatest loss is in weight, which amounts to ten or fifteen pounds in a hundred, varying with the lightness or heaviness of the tobacco. After it has gone through the sweat securely, which takes from three to four months, the ends of the boxes are opened, and samples are drawn from different layers in the boxes by inspectors, who, for a fee of 35 or 40 cents per case, varying with localities, guarantee the samples to represent the average quality of the box. A dealer may sample his own goods by giving a guarantee that the samples are a fair average. These samples are labeled and carefully packed in boxes, and all sales are made by them. There are many towns where warehouses are erected and some business is done; indeed, almost every village in the tobacco-growing districts does more or less business in tobacco.

PRICES OF TOBACCO.

The average price of the crop of 1879 in the several counties and districts was as follows: New Haven county, Connecticut, 14 cents; Middlesex, Hartford, and Tolland counties, Connecticut, 16 cents; for the Housatonic valley, 15 cents; Hampden county, Massachusetts, 9 cents; Cheshire county, New Hampshire, 9 cents. For the different grades the following prices prevailed:

Counties.	Wrappers.	Seconds.	Fillers.
	Cents.	*Cents.*	*Cents.*
New Haven, Connecticut	15 to 25	8	5
Middlesex, Hartford, and Tolland, Connecticut	15 to 25	5 to 6	3 to 4
Hampden, Massachusetts	15	8	4
Hampshire, Massachusetts	13	5	5
Cheshire, New Hampshire	13	5	5
Housatonic valley	15 to 25	6 to 8	4 to 5

It will be seen that the average price of the product in Middlesex, Hartford, and Tolland counties is higher than in any other counties in the Connecticut valley, and yet the price of wrappers is no higher than in New Haven county, and for inferior grades hardly equals the upper counties of the valley. This apparent anomaly is, however, of easy explanation. The three counties of which Hartford forms the center have a much larger proportion of fine wrappers, amounting to 66 per cent. of the crop, while the other counties have a larger proportion of inferior grades. This would make the average of the crop in the first district named greater. Beside, in the upper part of the valley, a larger proportion of Havana is raised, the seconds and fillers of which bring a much higher price in the market than the seconds and fillers of the Connecticut Seed Leaf.

As a general thing, the tobacco of the same variety grown in Massachusetts, New Hampshire, and Vermont does not sell as high by 25 per cent. as that grown in the Hartford district.

The prices paid farmers for crop through of Connecticut Seed Leaf in the Housatonic valley from 1870 to 1879 are as follows:

Year.	Worst crops.	Best crops.
	Cents.	*Cents.*
1870	10	30
1871	5	20
1872	5	25
1873	5	12
1874	10	25
1875	5	18
1876	5	15
1877	5	15
1878	5	16
1879	5	20

Havana began to be planted in the Housatonic valley about the year 1875, and the increased inquiry for it in 1877 induced a considerable planting, the farmers who had poor, thin soils finding it to be much more profitable than the Connecticut Seed Leaf; but upon soils of marked fertility, generally, but not always, the latter variety is preferred.

COST OF TOBACCO PRODUCTION.

In the Hartford district, composed of the counties of Middlesex, Hartford, and Tolland, the price of the best tobacco lands will average $200 per acre. The rate of wages during the active farming season, usually from the middle of March to the middle of November, is $15 per month for men; by the day, in summer, from $1 25 to $1 50. At the period when the ravages of the horn-worm are most destructive it is frequently necessary to employ extra hands, and it is always necessary to do so in harvesting. The following estimate of the cost of cultivating, handling, etc., one acre in East Hartford will be found very nearly correct:

Making seed-bed	$2 50
Seed	25
Weeding and attention to plant-bed	1 50
Rent of land (interest on value)	12 00
Stable manure, six cords, at $8	48 00
Three hundred pounds guano, at $56 per ton	8 40
Cost of applying manure	4 00
Plowing land twice	4 00
Harrowing and ridging	3 00
Making hills	1 50
Drawing and setting plants	4 00
Cultivating and hoeing three times, each $3	9 00
Topping, worming, and suckering	15 00
Harvesting	12 00
Taking down, assorting, and stripping	20 00
Bulking	1 00
Use of barn, laths, wagon, etc	12 00
Delivering to market	3 00
Total	161 15

A plan very generally adopted by the planters of the Connecticut valley is to contract to pay 3 cents per pound to the laborer for all the work necessary to be done in cultivating and handling the crop until ready for market, the landlord furnishing land, team, implements, barns, etc., and delivering the crop to market. The use of team, implements, etc., is estimated to be worth 1 cent per pound. The cost of producing a crop of one acre on the basis of this contract is:

Labor for one acre	$60 00
Use of team and implements	20 00
Manure (average amount), six cords, at $8	48 00
Three hundred pounds guano, at $56 per ton	8 40
Use of sheds and laths	12 00
Rent of land (interest on investment)	12 00
Delivering crop to market	3 00
Total	163 40

When twine is used, $1 should be added to the cost. This makes the cost about the same, whether the labor is employed by the pound or in the ordinary way. Both these estimates have been made on the basis of a yield of 2,000 pounds per acre, which is understood to be the yield of the best crops for the best portion of the Connecticut valley. The first estimate makes the cost $8 06 per hundred pounds, and the second $8 17. Assuming the average yield per acre of the Connecticut valley to be as the Tenth Census indicates, 1,620 pounds, the cost per hundred pounds to produce it would be, on the basis of the first estimate, $9 95, and on the basis of the second estimate $10 09. The average value per acre for the whole of New England being $217 19, from which deduct cost, $162 27, would leave a net profit per acre of $54 92.

In the Housatonic valley the cost of raising tobacco does not vary much from the cost in the Connecticut valley. Labor costs from 3 to $3\frac{1}{2}$ cents per pound. The whole expense for an acre of Connecticut Seed Leaf grown in the Housatonic valley is given as follows:

DR.	
Labor	$60 00
Manure	50 00
Use of land (interest on investment)	12 00
Use of team and tools	20 00
Use of barn and laths	10 00
	152 00
CR.	
By 2,000 pounds of tobacco, divided as follows:	
1,200 pounds, at 25 cents	$300 00
666 pounds, at 10 cents	66 60
134 pounds, at 5 cents	6 70
	373 30
Deduct cost	152 00
Profit	221 30

Cost to produce, per 100 pounds, $7 60.

The Havana tobacco, though requiring the same amount of expenditure per acre for manure, rent of land, etc., would probably require 16⅔ per cent. more labor to cultivate, in consequence of the increased number of plants to the acre. Connecticut Seed Leaf, set in rows 3½ feet apart and the plants 2½ feet asunder, will give nearly 5,000 plants (4,978 accurately) to the acre. Havana is set in rows 3 feet apart, and the plants at the distance of 2 feet in the rows, which gives 7,260 plants to the acre, or 2,282 plants in excess of an acre planted in Seed Leaf. It involves as much labor to set, worm, sucker, cut, and spear a small plant as a large one, and the estimate of 16⅔ per cent. of labor additional does not appear too great. On this basis the cost of growing Havana tobacco will be as follows:

DR.

Labor for one acre	$70 00
Other expenses, as above	92 00
Total cost	162 00

CR.

By 1,350 pounds of tobacco, divided as follows:	
810 pounds, at 40 cents (extreme price)	$324 00
450 pounds, at 12 cents (extreme price)	54 00
90 pounds, at 7 cents (extreme price)	6 30
Total value	384 30
Deduct cost	162 00
Profit	222 30

Cost per pound, 12 cents.

Averaging the cost of production per hundred pounds of the two varieties, and it will be $9 80; but in both the estimates of yield the best tobacco soils only are considered. Taking the average yield of the whole valley at 1,328 pounds and the average price at 16 cents, the money value for each acre cultivated would be $212 48, from which deduct the average cost of production, and it would leave an average profit of $82 34 per acre.

It has not been satisfactorily settled which variety is the most profitable to plant on good soils. The Connecticut Seed Leaf always grows well, and the Havana always meets with ready sale, often at prices greatly beyond expectation; but the raising of Connecticut Seed Leaf appears to be accompanied with less uncertainty, the yield per acre and the prices received for the product being more uniform. The average number of acres allowed to a hand is from 2½ to 3.

Good tobacco lands in the Housatonic valley are worth from $50 to $200 per acre, according to the distance from railroads, and sometimes, when convenient to transportation, they will rent for $50 per acre for a single year, the landlord agreeing, however, to furnish the manure for the tobacco crop. Labor commands from $18 to $20 and board per month. From $1 to $1 25 and board is paid for men by the day in summer. Dealers pay for best packers $2 per day, and give 1 cent per pound for assorting tobacco and tying it into hands ready for the packer.

In Hampden county, Massachusetts, the prices of the best tobacco farms are put at $150, $200, and $250 per acre, according to location and improvements on the farm. These lands rent for $50 per acre, or one-half the crop, the landlord in the latter case furnishing everything except labor. Stable manure is worth from $5 to $8 per cord. The wages of labor are from $15 to $18 and board per month. The following estimate of the cost of growing a good crop of tobacco was made by Charles F. Fowler, of Westfield, Hampden county, Massachusetts:

DR.

Cost of making seed-bed	$2 00
Weeding and attention to seed-bed	2 00
Rent of land (interest on price)	12 00
Stable manure per acre	60 00
Guano or superphosphates	15 00
Cost of applying fertilizers	12 00
Cost of breaking one acre twice	4 00
Harrowing, lining out, ridging, and hilling	4 00
Drawing and setting out plants	4 50
Cultivating and hoeing	12 00
Topping, worming, and suckering	12 00
Harvesting	15 00
Taking down, assorting, and stripping	25 00
Bulking	2 00
Use of barn, laths, wagon, etc.	10 00
Delivering crop to market	3 00
	194 50

CR.

2,000 pounds tobacco, at 14 cents	$280 00
Deduct cost	194 50
Net profit	85 50

This will make the cost per hundred pounds of Seed Leaf $9 72. Mr. Fowler, who made this estimate, says in conclusion:

This is not intended as an estimate for an average crop, but for a good crop. By the application of less manure, the cost and also the profits would have been reduced.

He further says: "It requires from sixty to seventy days in most favorable weather to cure the crop." This county reports the largest yield per acre for 1879 of any county in the United States, it being a little over 2,127 pounds.

George H. Gaylord, of Hampshire county, Massachusetts, estimates the value of good tobacco farms at $300 per acre; value of stable manure in winter, $8 per cord; in spring, $10 to $12. The wages of labor are $25 per month without board, or $1 25 per day. Contracts are sometimes made to pay a laborer $80 per acre for doing all the work required on a crop of from 2½ to 3 acres of tobacco, or the crop is divided, the landlord being at all expense, except labor. The itemized statement of the cost of producing an acre of tobacco is as follows:

DR.	
Cost of making seed-bed	$0 50
Weeding and attention to seed-bed	3 00
Rent of land (interest on price)	18 00
Stable manure applied per acre	80 00
Cost of applying same	20 00
Cost of breaking land twice	3 00
Harrowing, lining out, ridging, and hilling	3 00
Drawing and setting out plants	5 00
Cultivating and hoeing	10 00
Topping, worming, and suckering	6 00
Harvesting	10 00
Taking down and stripping	8 00
Bulking	1 50
Use of barns, wagon, etc	15 00
Delivering crop to market	2 10
	185 10
CR.	
By 1,700 pounds, at 15 cents	$255 00
Deduct cost	185 10
Net profit	69 90

Cost per pound, 10.9 cents.

It will be observed that in two items, that of making seed-bed and that of taking down and stripping the crop, there is a wide difference in the two estimates. This discrepancy is easily reconciled, for doubtless in the estimate made by Mr. Fowler the land for the seed-bed was burned over, which involved some expense, and this appears further from the fact that in the item for weeding and taking care of the bed the charge is much less in his statement than in that of Mr. Gaylord's, thus making the cost of seed-beds approximately equal. The wide difference in the cost of stripping arises from the fact that in the latter case it was tied up in large bundles without assorting or tying in hands. The other items approximate as closely as could be expected.

In Cheshire county, New Hampshire, $100 per acre is the price for the best tobacco farms. Stable manure costs $1 50 per cart-load, twenty cart-loads making seven cords, or about $4 30 per cord. Labor is worth $20 per month and board. The cost of cultivating and marketing an acre of tobacco, as estimated by George H. Gilbert, of Keene, is as follows:

DR.	
Cost of making seed-bed	$1 00
Cost of seed	25
Weeding and attention	1 00
Rent of land (interest on price)	7 00
Stable manure, per acre	30 00
Guano or superphosphates	12 00
Cost of applying fertilizers	10 00
Cost of breaking an acre twice	5 00
Harrowing, lining out, and hilling	5 00
Drawing and setting out plants	5 00
Cultivation and hoeing	10 00
Topping, worming, and suckering	5 00
Harvesting	10 00
Taking down, assorting, and stripping	8 00
Bulking	4 00
Use of barn, laths, wagon, etc	6 00
Delivering crop to market	4 00
	123 25

Cr.

2,000 pounds at 12 cents	$240 00
Deduct cost	123 25
Net profit	116 75

Cost per pound, 6.16 cents.

Some of the returned schedules put the cost of production at from $10 to $12 50 per hundred pounds, which is probably a little higher than the facts would justify for the Connecticut Seed Leaf. It comes, however, very near the true cost of growing the Havana Seed variety, which yields only from 1,200 to 1,500 pounds to the acre.

Sometimes tobacco is cultivated on the so-called "share system". These contracts are varied sometimes by the landlord's agreeing to feed the team and to furnish implements, the laborer feeding himself, or paying board in all cases where he works on "halves". The quantity which one man can successfully manage is estimated to be 2½ acres.

In the warehouses the price paid assorters is $2 per day; packers, $1 50 per day, both being classed among skilled laborers. A competent assorter must have an eye for color and a knowledge of grades, which can only come from long experience. The packer should be acquainted with the proper condition in which to pack tobacco, so that it may go through the sweat with safety, and should be able so to dispose the bundles in the boxes that when drawn they may come out straight, with smooth leaves. As a general thing, laborers who know how to manage a tobacco crop successfully command higher wages than ordinary farm hands.

In consequence of the increased skill exercised in the management of the crop, the proportion injured by pole-sweat and excessive sweating is becoming less and less each year, and the last may be said even now to be inappreciable. The former is becoming more rare as the sheds are improved and new methods of ventilation are adopted.

QUALITY OF TOBACCO GROWN.

The quality of the tobacco grown in the Connecticut valley near East Hartford stood for many years without a rival as a wrapper. It is a very handsome, showy tobacco, and is very attractive when new. More recently, however, its light color has reduced its rank; but its fine burning qualities and sweetness of taste, added to its silkiness of leaf, still make it a formidable competitor in the markets.

"New England tobacco," or that grown in Massachusetts, Vermont, and New Hampshire, is heavy, with, comparatively coarse stems and fiber, and is altogether of a lower class when compared with the best Connecticut leaf or the Pennsylvania tobacco. It is deficient in oily substance, and does not sweat to a good rich color.

The points around which the finest Connecticut Valley tobacco grows are East Hartford, Windsor, Suffield, and Warehouse Point. There is a marked difference observed between the tobacco grown on the east and the west sides of the Connecticut river, the former growing a light-colored, fine tobacco; the latter, a tobacco of more substance, but not so delicate in fiber. Sandy soils are more common on the east; clayey soils on the west.

It is generally conceded, both by dealers and by manufacturers, that the finest tobacco for cigar wrappers comes from the Housatonic valley, having all the silkiness of texture and burning qualities of the Connecticut Valley leaf and all the desirableness of color of the Pennsylvania Seed Leaf. In elasticity of leaf, in fineness of face, and richness of color it stands unrivaled, and brings a higher price in the market than any other seed leaf grown in the United States. The tobacco of the Connecticut valley is of fine fiber, has admirable burning qualities, and is of good size, but the color is generally too light to suit the present requirements of the market. The Connecticut Valley tobacco has a delicate, sweetish taste, and burns with a solid, yellowish ash, which presents an oölitic surface, considerably reduced in size from the original cigar. The tobacco grown in the Housatonic valley also leaves a pleasant taste, and burns with a similar ash.

The following statement shows the production, acreage, yield per acre, value of crop in farmers' hands or in primary markets, value per pound, and value per acre, of the tobacco crops of New England for the years 1876 1877, 1878, and 1879, only the figures for the latter year being from census returns:

Year.	Production.	Acreage.	Yield per acre.	Value in primary markets.	Value per pound.	Value per acre.
	Pounds.		*Pounds.*		*Cents.*	
1876	18,709,108	10,834	1,727	$1,964,456	10.50	$181 33
1877	18,458,578	10,686	1,727	2,030,443	11.00	189 97
1878	18,309,175	10,728	1,707	2,059,782	11.25	192 04
1879	19,717,398	12,199	1,616	2,649,982	13.44	217 19

All the tobacco grown in New England does not enter into the commerce of the country, a small portion being taken by local manufacturers, and another small part of it being retained for home consumption. This will account for the discrepancy between the receipts at the principal markets and the returns of the census enumerators.

CHAPTER XX.

GENERAL INFORMATION NOT SPECIALLY GIVEN IN THE REPORTS ON THE CULTURE AND CURING OF TOBACCO IN THE SEVERAL STATES.

SEED-BEDS.

In Virginia, Kentucky, Tennessee, and in other southern tobacco-growing states, the methods of preparation are substantially the same, such variations from the general plan as do exist depending altogether upon local conditions.

The site for a plant-bed most usually preferred is that having a southern or southeastern exposure, that it may have the genial and fructifying warmth of the sun in early spring, so that the plants may be set out before the hot weather of summer. If the bed can be located near a stream, fogs will quicken the germination of the seed and the growth of the plants. Probably the best possible location is on a gently-sloping hill on the north side of a running stream, but sufficiently elevated to be above any danger from overflows. In such situations plants are often two weeks in advance of those in beds prepared on level land. The timber growth may be of any kind that denotes fertility of soil.

In Virginia, Kentucky, and Tennessee a dark-colored, almost a black, soil is preferred, because it is more readily warmed by the rays of the sun, and retains the heat much longer than light-colored soils. For the same reason a slight intermixture of gravel will be of advantage. In North Carolina, although many planters prefer a black soil, free from sand or gravel, the majority of fine-tobacco growers choose a sandy soil, such as that in which the plant is to be grown to maturity.

In Virginia, except where wood for the purpose is scarce, in North Carolina, Kentucky, Tennessee, Missouri, and in many tobacco districts in other states, the practice of burning over the seed-beds is general. The burning is not slight, as in the Connecticut valley, where this appears to be done simply to destroy the seeds of weeds and grass, but the soil is burnt until it shows a reddish tinge. Several methods of burning are practiced. In all cases the wild growth is first cut off with an ax and not dug up. Leaves and trash are carefully raked off from the bed space. If the intention is to burn with logs, skids or poles are laid down four feet apart and a layer of logs and smaller wood, four or five feet wide, is built upon the skids, the object being to keep the wood from resting on the ground, so that the heat may have full play upon the surface of the soil. The fires being set, they are kept burning for two hours or more, when the whole layer is moved forward by hooks, so as to cover another space of the intended seed-bed; and this is kept up until a plat is burned as large as desired. Another method is to lay down brush and bits of wood at one end of the bed space until the pile is five or six feet high. Against this pile brush from tree-tops is placed in a position nearly vertical, inclining against the foundation sufficiently to prevent its falling back on the bed; and this is continued until the full space intended for the plant-bed is covered. A platform of wood is then put on top of the brush, and the fire set on the windward side. Still another plan is sometimes adopted, which saves the hard labor of covering the brush with heavy wood. After a width of eight feet of the bed space has been covered with brush placed in a nearly vertical position, logs or sticks of wood eight feet long are set on end, leaning against the brush. Eight feet more of brush is followed by another layer of wood, and so on until the whole space is covered. When fired the brush burns out quickly, but not before it has set the wood on fire, which, falling all in one direction, covers the whole surface with hotly-burning wood. Old broken rails, thrown aside in resetting fences, and old logs from dilapidated buildings are preferred, because they are thoroughly seasoned and burn freely.

When the bed has cooled off it is generally dug up with grub hoes or worked lightly and closely with a colter plow. The ashes should be left on the bed, and in working the soil it should be reversed as little as possible. All grubs, roots, and large stones should be removed, and the surface soil should be worked several times with hoes or rakes until it is perfectly light and mellow. When in proper condition, marks are made four feet apart to regulate the sowing of the seed. About one large heaping tablespoonful is enough to sow one hundred square yards. The seed is mixed with ashes or plaster, one half of the mixture being sown as evenly as possible over the entire bed, when the other half is sown in the same way. This is in order to secure a more equal distribution of the seed. The bed is then tramped or rolled, and finally covered with light brush—the smaller branches of dogwood, oak, gum, or sassafras—not thick enough to exclude the sunlight, but sufficient to protect the plants from frosts and the chilling and drying effects of the March winds. The brush also serves to keep the bed moist. Some care is required to put the brush upon the bed properly. The butt ends of the first layer should be laid on the ground outside the bed, the soft brush resting upon the bed, those of the second layer resting upon the bushy part of the first, and so on until the bed is covered by successive layers. In this way the thick, heavy ends, which would interfere seriously with the growth of the young plants, are kept above the surface of the bed. A covering of this kind will protect the plants against very hard freezing. In Wisconsin and in northern Illinois marsh or prairie hay is used, just enough to mitigate the severity of the rays of the sun and prevent the drying of the surface by winds until the plants start to grow, which requires a period of two or three weeks, when the hay is removed.

The covering of brush is generally allowed to remain upon the bed until the plants are nearly large enough to set out, but it may be necessary to remove it temporarily, in order to pick off any leaves or other trash which the winds are apt to drive upon the beds. To prevent the accumulation of leaves upon a bed prepared in or near a forest wicker fences, built of brush interwoven between sticks driven into the ground, have been found very efficient.

Trenches dug across the upper end of the bed and along the sides prevent flood-water from sweeping over the surface. Heavy rains are sometimes very injurious, washing the seeds from a portion of the surface and depositing them in depressions.

It is the usual custom to defer manurial applications until the plants are up and well started. Liquid manures are frequently used at this stage. A tight barrel, half filled with cow dung, is placed near the bed, water is added to fill the barrel, the mixture is stirred until it is a semi-liquid mass, and this is sprinkled on the bed with an old broom. Some prefer a solution of guano, a gallon of this fertilizer being mixed with a barrel of water and sprinkled upon the plants. These applications may be repeated one or more times with decidedly good results. Land plaster has proven to be a good application, giving a deep green color to the plants, indicating vigorous and healthy growth.

A hundred methods are practiced or suggested to prevent the ravages of the flea-beetle, but only one plan has proven really effective—to cover the bed closely with canvas or unbleached cotton cloth. A frame is first made around the bed of planks 8 or 10 inches high, care being taken to close every crevice between the planks and the ground. A few wires may be stretched across, the better to hold up the cloth, which is stretched over the frame and closely tacked upon the edges. In place of the wires, a small quantity of light brush thrown upon the bed will help sustain the weight of the cloth. A better plan would be to construct a number of smaller frames, of proper width and not more than 6 or 8 feet in length, upon which the cloth may be stretched and neatly fastened, a sufficient number of these frames being provided to cover the intended plant-bed. Such frames, with their covering, could be removed when no longer needed and stored for future use. If the cloth is treated with a single coat of white lead and oil, such as is used for the first coat of outside work on wood, it will last several seasons with ordinary care. Still another plan may be found more economical. The frames may be made and properly braced by cross-pieces let in flush with the upper edges of the planks. The cloth or canvas may be some three inches longer and wider than the frames, and hemmed upon the edges, and eyelet holes may be worked along the edges, two feet or less apart, in which cords may be fastened by which to stretch the cloth and tie it down closely over the frames to nails, hooks, or wooden pegs driven into the outer faces of the frame planks, three or four inches below the upper edges. Other devices will suggest themselves to the intelligent farmer, by which he can make the cloth covering effective, easily handled, and economical.

When the plants are nearly large enough to be set out this protecting cover should be taken off in the morning for two or three days and replaced in the afternoon, that the plants may be gradually hardened by exposure to the direct rays of the sun and better fitted for transplanting.

It often happens that a dry season occurs after the first drawing of plants, and those that remain on the bed cease to grow, turn yellow, and perhaps die. One or two planks and a few blocks of wood should be provided. A block on each side of the bed will support a plank, upon which the person drawing the plants should stand. Nothing injures a plant-bed so much as compacting it when wet, and as plants are almost always drawn when the soil is wet no pains should be spared to prevent treading upon or otherwise compressing the bed. If from any cause the plants begin to turn yellow and wither away shade must be provided by building over the bed a low arbor of green boughs and watering the surface copiously. This will almost always give new vitality to the enfeebled plants.

A practice of many good planters is to resow the beds with about half the quantity of seed originally used as soon as the first plants appear, so that if the first plants are destroyed in any manner the seed last sown will be undergoing the process of germination and a second crop of plants will be assured.

In Tennessee and in North Carolina plant-beds may be prepared and sown at any time from the 1st of November until the 1st of April. Prepared while wet or frozen, a plant-bed rarely does well. Beds are usually burned in February or March; but if the burning is done in the fall, when the soil is dry, less fuel is needed, and the prepared bed may be left to the meliorating influences of the winter freezing, to be sown in the early spring. Many good farmers sow the fall-burned beds as soon as prepared, but there is some risk in so doing. Heavy rains and melting snows are apt to wash or drift the seeds, and so disturb their uniform distribution. One of the best tobacco-growers in the South says that a rod of land well burned in the fall will furnish as many good plants as twice the area burned in February or March.

In some parts of Virginia and Maryland, and in districts where wood and brush are scarce, farmers have succeeded in growing good plants upon plats of clean soil without burning by the use of guano, raked into the surface, or as a top-dressing, applied at the time of sowing the seed, about 40 pounds per hundred square yards. Others select a standing bed, one that has produced plants well, in a warm location, neither too wet nor too dry; coulter over the bed after the planting season is past and before any grass or weeds have gone to seed upon the plat; cover with straw, leaves, or brush with the leaves on, or with all of them, so thick as to completely hide the surface and prevent vegetable growth. A bed is thus made ready for burning at some dry time from November to

January, or later, which is done by simply applying a torch. By this method a standing plant-bed can be annually prepared which, if heavily manured, will become better each succeeding year.

In Pennsylvania, New York, the New England states, and in Ohio, burning is rarely practiced, and then only so far as may be thought necessary to destroy weed and grass seeds in the upper surface soil. The same seed-bed is used for successive years, kept clear of grass and weeds throughout the year and heavily enriched by an addition of fresh loam from the woodlands, composts of stable manures thoroughly rotted, and so handled that no foreign seeds capable of germination are left therein, and frequently top-dressings of good commercial fertilizers are used. The most successful growers in Ohio and in New York use manures from the hog-pen, as not only the richest, but as most likely to be free from noxious seeds. In the New England states seed-beds are enriched with guano, castor pomace, well-rotted stable manure, the refuse of the fish-oil factories, or some one of the numerous manufactured fertilizers. In most of the northern states it is a very common practice to sprout the tobacco seed before sowing. The seeds are mixed with dark, rich loam, or, what is better, as in Wisconsin, with finely-pulverized rotten wood from the hollow of an old stump or log, and placed in a pan or dish in a warm place and kept moderately damp by frequent sprinkling with tepid water. The seeds germinate under such conditions in about two weeks, and are sown as soon as danger of frost is passed. Another plan is to spread the seeds very thinly upon a piece of dampened cotton cloth and cover them with another cloth, but of wool; the two are made into a loose roll, the woolen cloth outside. This roll is kept in a warm place, dipped in tepid water every day, and the white germs appear in from four to six days. In northern Illinois similar cloths are kept moist and warm in a pan of earth, of which there is a layer above as well as below the cloths. Great care is necessary in all these forcing processes. Sometimes the soil of the plant-bed is too wet, or otherwise not in proper condition when the seeds are ready, and when a delay of a day or two may render the sprouted seeds useless. The prudent man provides against such danger by preparing several lots of seed at intervals of several days.

The most common error in sowing tobacco seed, both north and south, is in using too much seed. Tobacco seeds are exceedingly small, an ounce containing about 340,000 seeds. One large, well-developed tobacco plant will produce seed enough to grow plants to set 10 acres certainly, and, should all of them germinate and grow, enough to set out 100 acres. Crowded plants must struggle for existence, are never strong and vigorous, and bear transplanting badly; those that have room enough to grow thriftily will have a thick tuft of roots, a low, stocky top, and a vigorous constitution, growing off quickly when transplanted. It is far better economy to increase the size of the bed than to attempt to produce a large number of plants by thick seeding.

A bed of 100 square yards will usually furnish plants enough to set 6 or 7 acres; sometimes a bed of this size will produce enough to set 10 acres. No tobacco-grower ever regrets having a surplus of plants, for in that case he can select the best and set out his whole crop early. On new land very small plants may be set, and at any time immediately after the late frosts without risk. For old lands plants should be a little more advanced than such as can be safely planted upon new lands, but as the season advances larger plants are required for both old and new lands.

INSECT ENEMIES OF THE TOBACCO PLANT.

From the first appearance of the minute seed-leaves in the plant-bed until the tobacco is cut and hung in the barn the patience and watchfulness of the farmer are taxed to guard against the depredations of insects.

Among the earliest to appear, often attacking the plants and destroying them so early as to make the planter doubt whether the seed had even germinated, are the "garden fleas", sometimes called "snow fleas" and "spring-tails" (*Smynthurus hortensis*). When viewed from the upper side (dorsal view), the most conspicuous divisions are a large head and an abdomen perfectly smooth and plump, without any segmental cross-lines. The thorax seems confluent with the abdomen. Beneath are some transverse wrinkles, indicating segmental divisions. The antennæ are three-fourths as long as the body, elbowed about the middle, and are composed of nine joints, six very short and three very long. Projecting from the posterior of the abdomen is a cone-shaped process, composed of three distinctly marked segmental lines, that appear to be a caudal termination of the body. On the lower side of the abdomen, and near its end, is a forked member (a spring-tail), which lies folded up against the under side and reaches as far forward as the head, in which lies its leaping power. Its feet, six in number, are united apparently to the front of the abdomen, which, from a ventral view, exhibits a rudimental sternum, compensating for the absence of the thorax usual in insects. This insect has neither wings nor wing covers, and from a top view might be mistaken for a small, black spider by a novice if he did not know that a spider has eight feet, and that the head and thorax are confluent, instead of the thorax and abdomen. These insects are capable of bearing a low temperature, and are frequently found upon the surface of the snow, from whence comes the name of "snow flea". Tobacco-growers complain of these pests under the name of "black fly", "black spider," etc. Their larval and pupal histories seem to be unknown. They are found in all the states of the Atlantic coast, but have not been observed in the interior. They appear as far north as Lancaster county, Pennsylvania, during the months of May and June, but by the first of July they have disappeared, and nothing more is seen of them until the following spring. As a remedy flour of sulphur has been highly recommended. These insects are very delicate in their structure, and cannot be taken between the fingers without crushing them. As it is evident that the first stages of their development must be passed underground and not far below the surface, it is suggested that where tobacco-beds are not burned the soil be prepared early, thoroughly pulverized, and copiously drenched with scalding water three or four times in as many days before the seed is sown.

From all parts of the United States come reports that the flea-beetle is the most persistent and most dreaded enemy of the young tobacco plants. Several species of these insects are well known to every farmer and gardener from the Gulf of Mexico to Canada. The cabbage flea (*Haltica striolata*) is found in North Carolina and Tennessee in the latter part of March or early in April, sometimes in immense numbers, in the newly-planted cotton-fields, feeding upon the seed-leaves of the young plants. Dr. Rathoon, of Pennsylvania, describes two species of the genus *Epitrix*, family *Halticidæ*, as follows: The *Epitrix cucumeris* is black all over, except the antennæ and the feet. The thorax is thickly punctured, and the wing covers conspicuously striated and punctured between the striæ. The *Epitrix pubescens* is slightly more oblong, and not quite so convexed as the former, but otherwise is about the same size. The whole of the body beneath is of a dull-black color, including also the posterior thighs. The feet, the antennæ (which are slightly serrated along the anterior margin), and the whole of the dorsal or upper part of the body, are of a honey-yellow color, except about a third of the middle portion of the wing covers, which is a dusky black. The thorax is of a much brighter color than the other upper portions of the body, and the eyes are very black, their composite character being more distinct than in the first-named species; and except the thorax, the upper and lower part of the whole body is pubescent. This pubescence is conspicuous in rows between the striæ of the wing covers and along the margins of the abdominal segments. This species is the most troublesome to the young cotton and cabbage plants of the middle southern states. They also attack the seed-leaves of beans and other leguminous plants, but appear to have an especial fondness for tobacco. These insects are about one-sixteenth to one-tenth of an inch in length.

The above-named and other species of the Halticans feed on a variety of plants. The sweet potato, cabbage, beet, turnip, radish, horseradish, common nettle, and the Jamestown weed are all infested by one or the other and often by the same species of this omnivorous family. When disturbed, the flea-beetles leap off the plants and hide themselves quickly in the dry soil or under small clods. Various solutions, poisonous or simply distasteful to these insects, have been used with successful results. Ashes, slaked lime, and soot, dusted upon melon, cucumber, potato, and turnip plants, and applied in the morning, when the dew is on the plants and while the beetles are sluggish, are effectual in most instances. Of various plans to keep them from tobacco-beds probably the only certain protection is to cover the seed-bed with cloth, as suggested heretofore.

Transplanted into the field, the tobacco plant is exposed to the attacks of other insects. The greasy cut-worm usually cuts off the plant just beneath the surface of the soil without cutting the top at all. When these worms are disturbed, they immediately coil themselves into a ring. They do not like the sunlight, and during the day bury themselves in the lower soil in the vicinity of the plant. When grown, they are from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long. They bury themselves beneath the soil to pupate. The pupa is three-fourths of an inch in length, of a shining or glossy light-brown color, and the anterior margin of the segments is dark brown. The anal segment is armed with two very small spines or points, by the assistance of which it pushes itself toward the surface about the time the moth is evolved. This moth is commonly called the Lance Rustic, from the dark-brown, lance-shaped spots on the anterior wings, which are a light brown in color. The hind wings are lustrous and whitish in color, with a grayish margin. The antennæ of the females are filamental or thread-like; but in the male, along the inner margin near the base, they are more or less pectinated. The body of the largest specimens is three-fourths of an inch in length, and the wings expand $1\frac{5}{8}$ inches from tip to tip. Cut-worms are largely preyed upon by hymenopterous and other parasites, and there is no better or safer remedy than hand-picking while they are yet in the larval state, discriminating in favor of the parasites when seen and known. Toads, lizards, snakes, and moles are all very useful in keeping these worms in check, and should be protected, excepting, of course, poisonous snakes. The cut-worms, in various stages of development, may be found in the earth during the entire winter, too torpid to feed until the return of warm weather. This accounts for their appearance and their advanced physical condition so early in the season. When cut-worms exist in large numbers, as in grass or clover sod or in fields not cleanly cultivated, fall or winter plowings, to expose as much as possible the upper soil to the severe freezings of midwinter, are absolutely necessary to secure a good stand of tobacco; but no matter how hard the frosts, nor how often the ground is plowed, some of the worms will survive, making daily inspection of the newly-planted field indispensable for an even stand of plants.

Wire-worms do not attack the leaf, but bore into the stems of the plants at the surface of the ground and work their way upward. After the tobacco gets a fair start in growth nothing is seen of these worms for the remainder of the season. They are the larvæ of "click-beetles", or "hammer-bugs" (*Elateridæ*). These worms are sometimes very numerous. In April and early in May, sometimes as late as the first of June, some of these species are very destructive in the corn-fields, especially upon lands which have been lying out for some years; but they are rarely troublesome in well-cultivated fields.

In Ohio, Pennsylvania, and perhaps farther northward, the *Heliothis armigera* (the southern boll-worm, or corn-worm) is sometimes found feeding upon the seed-leaves of young tobacco plants, but south of 35° these worms are rarely known to attack tobacco plants, since they find more appropriate food in abundance.

Some of the schedules returned state that in the earlier stages of growth in the field tobacco plants have been attacked by the *Epilachna borealis* (northern lady bird). This insect is shaped like the common "box turtle", is of a lemon-yellow color, spotted all over with black, and when caught in the hand emits a few drops of a clear yellow fluid of unpleasant odor. It is nearly as large as the Colorado potato beetle, but rather more hemispherical, and the larva, pupa, and *imago* are often found together on the same plant. They are usually found upon pumpkin, melon, and cucumber vines. The larva is a short, convexed slug, of a uniform bright yellow color, covered all over with short, bristly hairs, and has a pair of very black eyes. It undergoes all its transformations on the plants it infests, and the pupa is suspended by the adhesion of the caudal extremity. This species and several others of the same family hibernate beneath the rough outer bark of the wild cherry, and sometimes upon the apple trees in neglected orchards. These insects, as well as some others hereafter mentioned, are rarely found upon tobacco plants except near trees or shrubbery or close to fences.

Tree crickets (*Œcanthus niveus*) are often found upon tobacco plants in Tennessee, North Carolina, and other southern tobacco regions in July and August, and in Pennsylvania and farther north in August. Though usually found on trees, these crickets show a decided partiality for tobacco, perforating the tender top leaves about the time they are expanding. It does not kill the leaf nor arrest its growth, but the holes increase in size. Although these holes are circular when first made, they become oblong as the leaves lengthen, and always in the longitudinal direction of the leaf. These crickets, when young, either leap away or hide among the leaves when approached, but after their wings are fully developed they can both leap and fly to a considerable distance. The male tree cricket is nearly white, sometimes tinged with green; the wings lie flat on the back, one lapped over on the other; the legs are all long and slender, the posterior pair much the longest, and formed for leaping; the antennæ are very long and thread-like, and are generally thrown backward when the animal is at rest. The female is more robust and shorter in the body; the wings are short and deflexed, and her color is various shades of green and brown. Her legs and antennæ are also shorter than those of the male, and at the end of the abdomen she is provided with a sword-like ovipositor. She perforates the raspberry and blackberry canes, as well as the tender branches of other shrubbery, with this instrument, and deposits her eggs therein, where they remain all winter and hatch in the spring. Tobacco cultivators have noticed that these insects are most abundant on tobacco growing under or near trees. Clean culture, and the clearing up of fence corners and neglected spots about the tobacco-fields, will do much to prevent injury by crickets.

Various species of grasshoppers, especially the meadow grasshopper (*Orchilemum vulgare*), sometimes feed upon the tobacco plant, eating the leaves of the newly-set plants while in a wilted condition, but the injury from this source is slight, and rarely occurs with any but late plantings.

Several species of hemipterous insects puncture tobacco plants. These insects are true bugs, and are not provided with mandibular organs. They do not eat the plant nor cut holes in it, but are provided with a sharp proboscis, with which they pierce the plant and suck out its juices. One of these, the *Phytocoris linearis*, is a small gray insect about a quarter of an inch long, having generally a conspicuous yellowish V-shaped mark on the back, occupying that part called the scutellum. This bug is found upon the potato, and has been observed in Tennessee upon parsnip, tomato, and late cabbage plants. The *Euschistus puncticeps* is a much larger insect than that last described, and is capable of greater injury. It belongs to the family *Scutellaridæ*, distinguished by a triangular lobe that extends from the base of the thorax downward on the wing covers. This insect is half an inch long and three-eighths of an inch across at the broadest part. Above, it is of a yellowish color, and closely punctured darkly, giving it a grayish hue; below, it is a light greenish yellow. It has a longer and more slender proboscis than the species that prey upon other insects; otherwise it might easily be confounded with them, and no doubt frequently is. It also lacks the thoracic spines; but these are very variable in their development, and not always a safe distinguishing characteristic. These bugs are found on mulleins, thistles, and other weeds, and have also been found upon tobacco plants in several localities, feeding upon the sap of the leaves, but it is doubtful whether any great injury can be charged to their account. The ordinary observer is apt to mistake the purpose for which many insects visit various plants. The spined tree-bug (*Podisus spinosus*), the large tree-bug (*Podisus cynicus*), the *Stiretrus diana* (a plant bug of a purple-black color, with red or orange marks on the thorax and scutellum), and the *Stiretrus fimbriatus*, the ground colors of which are orange or yellow, with black markings, are sometimes found upon or in the immediate neighborhood of tobacco plants. These bugs should not be destroyed, unless upon careful examination they are found actually feeding upon the juices of the leaves, as it is more than probable that their presence is beneficial, rather than injurious.

From the early part of June until the sharp frosts destroy their food in the fall the larvæ of the sphinx moths infest the tobacco. In Virginia, Maryland, Kentucky, Tennessee, and Missouri both the *Sphinx carolina* and the *Sphinx quinquemaculata* are found, and they are both reported as found in the tobacco-fields as far north as latitude 41° 30′. South of latitude 35° only the *S. carolina* has been observed. The larvæ of these two *Sphingidæ* are so well known to all tobacco-growers as to need no description here. They have always been regarded as the most inveterate enemies of the tobacco plant, and, despite plans adopted for their destruction, the horn-worms seem to be as numerous as ever. In some seasons there are comparatively few in certain localities, but it has been noticed that the fields of such districts are often visited late in July or August of the next year by a "heavy shower" of horn-worms.

Comparative immunity for one season too often causes the farmer to neglect the destruction of the late brood of worms left upon the suckers which spring up after the crop is harvested, large numbers pupating and hibernating, protected by the forgotten and neglected trash of the tobacco-field. Catching the moths with ingeniously-contrived traps, poisoning them with sweetened cobalt dropped into the bloom of the Jamestown weed, or killing them with paddles as they hover about the tobacco plants after sunset, are all practiced. Recently, as in Tennessee, porcelain imitations of the blossom of the Jamestown weed have been introduced. These are fastened upon sticks, set up at short distances apart throughout the tobacco-field, and are supplied with a few drops of poisoned sirup. They are cheap, will last with ordinary care a lifetime, and are highly recommended by planters who have used them. A knowledge of the transformations of these insects will enable the observant farmer to do much to reduce their numbers, and if it were possible to secure prompt measures throughout a considerable section of country, or even by the growers of a large neighborhood, much disagreeable labor might be saved.

The moth deposits an egg of a sea-green color, not larger than a mustard-seed, upon the surface of the leaf. This egg gradually assumes a cream color, and from it, in due time, a tiny worm issues, not larger than a horse-hair, and about one-eighth of an inch in length. The process of hatching embraces from twenty-four to thirty-six hours, depending upon the condition of the weather. The worm begins to eat immediately, making first a small hole in the leaf, through which it passes in hot weather to the under side, and occasionally the eggs are there deposited by the moth. This worm, though voracious, does little damage for four or five days. Its power of destruction increases exceedingly with each day, and this makes it highly important to go over the field often in search of them.

When the horn-worm has attained full size it stops eating, comes down from the plant, and usually burrows into the ground close to its last feeding-place, but not unfrequently crawls away some distance to find soil sufficiently soft to enable it to get some inches below the surface. Here it becomes quiescent, casts off its larva skin, and assumes its pupal form. It is now oval in shape, four times as long as it is thick, about 1¼ inches in length, and the hard, glossy envelope is of a bright chestnut color. The forward end is prolonged into a long, tube-like appendage, bent backward and firmly attached to the chest, forming a loop like a pitcher-handle, this tube ensheathing the tongue, which is so remarkably developed in the perfect moth. Only under peculiar circumstances are these pupæ found at a greater depth than may be reached by deep plowing. A further means of reducing the number of these insects is therefore by fall or winter plowing the tobacco-fields. It must be said, however, that even if every egg, worm, moth, and chrysalid in a given neighborhood were destroyed, high winds, or even the lighter breezes of the summer evenings, bring other moths many miles. The tobacco-grower should instruct those in his employ not to destroy any horn-worm found with the cocoons of the parasite *Microgaster congregata* attached to its body. These cocoons are white, of a regular oval form, a little more than an eighth of an inch long and about one-sixteenth of an inch broad, and resemble small grains of rice. From ten to a hundred of these cocoons are found upon a single horn-worm. The worm so infested may be removed from the tobacco plant, but should be handled carefully and placed where the cocoons may not be injured, so that the parasites may hatch undisturbed. The flies which issue from the cocoons are black, with clear, transparent wings and legs of a bright tawny color, the hue of beeswax, with the hind feet and the tips of the hind shanks dusky.

The testimony of all tobacco-growers points to the one conclusion about insect enemies. No methods of prevention or destruction can justify a single day's neglect to search for and destroy cut-worms about newly-set plants and the eggs and larvæ of the sphinx moth upon the expanded leaves throughout the season.

DISEASES OF THE TOBACCO PLANT.

The tobacco plant is subject to certain diseases, few in number, however, and rarely resulting in very serious damage. Unfavorable seasons, too wet or too dry, often reduce the yield and impair the value of the product; but diseases, properly so called, seldom affect more than a few plants, or perhaps a small portion of a field. Schedules returned from widely-separated districts mention the same diseases, all of which result from deficiencies in the soil or its preparation, or from peculiarities of the seasons during growth.

A disease known in New England as "brown rust", and in the South as "firing" and "field-fire", prevails to some extent every year. It appears in very wet or very dry weather, and reports concur in the opinion that it is caused by violent changes from one extreme to the other. A plethoric plant with the supply of moisture suddenly cut off, and a lean plant forced by excessive moisture to rank growth—a leaf perishing in spots for lack of sustenance, and another from the opposite cause—present variable conditions, developing "rust" or "fire". This disease is not so prevalent in some districts as formerly, which is attributed by some planters to the substitution of new for old varieties; but it is more probably due to planting upon a different character of soil, or to more thorough drainage and improved culture. Sometimes, though rarely, the entire plant is involved, drooping and withering through excessive humidity. This is the "black fire", a strictly wet-weather disease. In dry weather the plant sometimes parches up, as if scorched. In uniform, ordinary seasons it does not appear. Injudicious use of heating manures is assigned as sometimes the cause of firing, and undoubtedly does occasionally produce "red" or dry-weather firing. Thorough drainage is regarded as the best preventive of this and its kindred diseases.

"Frenching", derived from the French *friser* (to curl), occurs almost exclusively upon cold, stiff uplands, having a close and stiff clay subsoil. During a wet season it is very prevalent upon clayey lands, and is sometimes found upon sandy soils in small basins during excessively rainy weather. This disease renders the plant worthless when it has progressed to any considerable extent. The effects are first seen in the buds of the plant, which become of a yellow color. The leaves afterward become thick and fleshy, have a semi-transparent or honey-colored appearance, and often curl around the edges downward, sometimes growing in long, narrow strips, with ragged outlines. When cured, the leaves are dull and lifeless in color, and very brittle. No remedy for the disease has been found. It is sometimes arrested by close plowing, or by giving the plant a vigorous pull, so as to break the tap root, but the only preventive measure is to avoid planting upon a soil not properly underdrained, either naturally or artificially.

"Walloon", or "water-loon", is of very common occurrence, and is closely akin to "frenching". The leaves, instead of curving over in graceful outlines, stick up like a fox's ears, whence the disease is known in some sections of the country as "fox-ears". When tobacco is thus attacked it becomes rough and thick, and is unfitted for any but the most inferior purposes. Excessive tenacity of the soil or defective drainage are causes of the disease.

"Hollow stalk" and "sore shin" rarely occur, except when the plants have been overflowed, and then mostly upon old lands. Some planters attribute "hollow stalk" to an insect feeding upon the pith of the lower stalk, or to the after effects of an attack by the wire-worm upon the young plant; others think it the effect of a bruise or a wound upon the stem of the young plant. The two names above given are descriptive of different appearances of the same disease. It is most probably produced by excessive absorption of water by the pith of the stalk while partially submerged and subsequent exposure to a high degree of temperature. It is not reported as occurring upon such lands as are never flooded by rain water, nor has it been observed upon soils well underdrained or overlying a porous subsoil. There is no remedy for it, and unless the plants are cut as soon as it appears they become worthless. The affected plant presents very much the same appearance as if nearly severed from the stalk, withering slowly without ripening.

"Frog-eye", or "white speck", sometimes occurs in tobacco thoroughly ripe. This disease, if it is such, is of rare occurrence, and is little understood. In Florida white specks are a sure indication of fine texture in the leaf, and this "frog-eye" appearance was at one time much esteemed. This particular marking seems to result from conditions of soil or climate, or from both, and some varieties are more frequently affected than others.

"White veins" occur in the cured product. By some they are believed to be caused by long-continued dry weather before and after cutting; by others they are ascribed to any check in the growth of the plant, whether for lack of manures, from deficient cultivation, drought, bad seed, or too much water. Some think they are caused by the absence of some soil constituent. All that can be said is that they do occur, very much to the injury of the leaf for wrapping purposes. As a general rule, the product from a field well prepared, well fertilized, and well cultivated, planted in good season, properly topped, and kept free of suckers, will show, when cured, very few white veins.

"Leprosy" is a name given to a fungoid mold which is occasionally found upon cured tobacco hanging in the barn during warm, moist winters. This mold affected a large portion of the crop of 1880 in the Ohio River valley, especially in southern Illinois, and in the lower Ohio River districts of Kentucky. This fungous plant increases with amazing rapidity wherever the spores find congenial lodgment, and even sound, dry tobacco is sometimes infected and seriously damaged. This disease, although not a new one, is imperfectly understood. Appearing to a serious extent only in weather congenial to its development, and propagated from spores which have escaped detection in badly-kept barns or tobacco-sheds, too many planters look upon it as of obscure or doubtful origin, or as an inevitable concomitant of unfavorable atmospheric conditions. The remedy is prevention. Thorough cleansing of the tobacco-barns, stripping, assorting, and packing rooms, and the careful destruction, by burning, of all the trash and dirt which accumulate about the premises, will secure well-handled tobacco against "leprosy", and perhaps other diseases of fungous origin.

TOBACCO STRIPS.

The making of strips, although a distinct branch of business, rarely, if ever, carried on by tobacco growers, is regarded as a part of the necessary preparation of the leaf when designed for shipment to English markets. This stemming process is employed almost altogether upon the heavier types of tobacco, so that the leaf, deprived of the midrib or stem, may be shipped in a dry condition. The tax in England on tobacco is 3*s.* 6*d.*, about 84 cents, per pound. On a hogshead of tobacco weighing 1,000 pounds net a tax of $840 must be paid to the government Assuming the tobacco to cost 15 cents per pound, the value of the hogshead, tax paid, would be $990, or 99 cents per pound. If it should have the capacity to absorb 15 per cent. of water, the profit from this would be $148 50. Tobacco selected for strips should therefore be porous and a "deep drinker". The greater its capacity for absorbing water, other things being equal, the larger the profit. Recently the government of Great Britain has taken cognizance of this source of profit, and now requires a duty of 3*s.* 10*d.*, about 92 cents, to be paid on all tobacco containing less than 10 pounds of water to the 100 pounds.

Details of the manner of purchasing tobacco for stemming purposes, the types used, and the method of assorting, preparing, and putting up strips for export, will be found in the special reports upon the states of Indiana, Kentucky, and Virginia.

Of the crop of 1879 there were put up during the fall and spring of 1879–'80, as nearly as can be ascertained, 17,315 hogsheads of strips; or, assuming the average net weight at 1,200 pounds per hogshead, 20,778,000 pounds, requiring about 31,000,000 pounds of leaf.

The estimated make of strips from the crops of 1876 to 1879, inclusive, were as follows:

Year.	Section.	Hogsheads.
1876	Virginia	8,500
	The West	26,000
1877	Virginia	7,500
	The West	33,000
1878	Virginia	6,000
	The West	10,000
1879	Virginia	4,300
	The West	13,015

Of the strips made in 1879–'80 there were put up at—

	Hogsheads.	Pounds.
Richmond, Lynchburg, Petersburg, and Farmville, Virginia	4,300	5,160,000
Henderson and Owensboro', Kentucky	5,675	12,240,000
Louisville, Russellville, and Paducah, Kentucky	2,000	
Minor points	2,025	
Evansville, Booneville, Corydon, Indiana, and other points	1,425	1,710,000
Clarksville, Paris, Springfield, and Nashville, Tennessee	1,290	1,548,000
Cairo, Illinois	100	120,000

A small quantity of White Burley strips was put up on the Ohio river below Cincinnati as an experiment; also about 500 cases of seed-leaf at Miamisburg, Ohio.

The preparation of strips for export is a business of considerable importance in a few cities and towns, as in Henderson, Owensboro', and Louisville, Kentucky; Richmond and Lynchburg, Virginia; Clarksville and Paris, Tennessee, and Booneville, Indiana. In these places a large capital is invested in warehouses and the necessary appliances for handling large quantities of tobacco. This branch of industry can, however, be successfully and profitably managed on a small scale, and there seems to be an increasing disposition to carry it on in close proximity to the districts which produce the types best fitted for the purpose. The saving in cost of handling, transportation, etc., of over 30 per cent. of weight has assumed more importance since there is no longer a profitable market for the stems and other waste of the factories.

CONCLUSION.

The tobacco plant exhibits a facility for adapting itself to diverse conditions, rivaling that of Indian corn, and excelling that of the potato. All three are plants thriving best upon soils rich in the salts of potassium. In all sections of the Union any well-drained soil capable of producing Indian corn will produce tobacco, the latter exhibiting, however, much more strongly marked diversity of characteristic qualities, as affected by variations of soils and of climatic conditions.

The best types of fine tobacco in the southern states are grown upon soils poorly supplied with vegetable matter and are poor in albumen, although sufficiently rich in nicotine, while the best types of the northern tobacco districts are grown upon lands purposely enriched with nitrogenous manures, to promote rapid growth and early maturity, and are also poor in albumen, burning freely without disagreeable odor, and are at the same time fairly supplied with nicotine. That these similar results should follow unlike conditions of fertility of soil can be attributed alone to difference of climate.

The special reports herewith submitted present another apparent anomaly. In the southern tobacco-growing sections the use of commercial fertilizers, while generally increasing the yield of pounds, has not resulted in an improvement of quality; and, *per contra*, in the northern states these fertilizers have almost always bettered the quality of the product.

Both north and south, on the Atlantic border and in the far interior, the surest reliance for an increased yield is the free use of composted or well-rotted farm-yard and stable manures, and these are almost invariably accompanied by a parallel improvement in quality.

It is asserted, with some show of reason, that the color of the cured leaf is correlative to the color of the soil upon which the plant is grown; and it is certain that upon dark-colored soils, and especially upon those containing a large proportion of clay, the stronger, heavier, and darker types are produced. Although the seed-leaf varieties grow finer and make a really superior quality of tobacco upon sandy soils, fashion has dictated that darker colors are most desirable for cigar wrappers, and the colors most in demand are grown upon argillaceous and calcareous loams. The fine yellow types of North Carolina and Virginia are grown upon light-colored arenaceous soils.

Tobacco culture, perhaps more conspicuously than any other kind of farming, exhibits the condition of agricultural progress in the regions in which the staple is produced. The revenue tax has had the effect of discriminating in favor of good tobacco, has really been an incentive to the production of finer types and better grades, and has induced better cultivation and more careful management. Progressive enterprise in tobacco growing has had most beneficial effects upon other agricultural pursuits. The tobacco-field usually occupies but a few acres upon the farm, and in most cases gets a large share, if not all, of the manures saved at home. It is upon these limited areas, in all parts of the country, that the most carefully-conducted and best authenticated experiments have been made with commercial fertilizers. Wherever tobacco culture has been made profitable, there has been an increase of all farm products suited to the locality.

In the preparation of these reports the object has been to furnish abundant information as to the geological position, the lithological constitution, and the geographical location of all soils which have been found specially adapted to certain classes and types of tobacco.

CHAPTER XXI.

REPORT ON THE CHEMISTRY OF AMERICAN TOBACCOS, BY GIDEON E. MOORE, PH. D.

Tobacco in commercial form represents the products of vegetable growth more or less changed by fermentative or putrefactive processes. The peculiarities of the different varieties are, therefore, of twofold origin, being due, first, to the diverse conditions of soil, climate, and mode of cultivation; and, second, to the effects of the processes of curing to which the harvested leaf has been subjected. While, therefore, it is permissible to trace out the relations between the nature and the relative amounts of the constituents of the finished commercial product and the properties upon which the technical application and commercial rank of the latter depend, the question of the influence of the diverse conditions, under which the cultivation of the different varieties has been effected, on the quality of the finished product, can only be decided from the results of the chemical examination when due regard is had to the modifying effects on the composition of the product, exerted by the processes of curing to which it has been subjected. These last consist either in simply drying the leaf by exposure either to the heat of the sun or to more or less carefully regulated artificial heat, in which case fermentative change is either avoided or reduced to a minimum; or they consist in a more or less perfect fermentation preliminary to, or simultaneous with, the operation of drying, and in this case result in essential modifications in the composition of the leaf and degree of adaptability to the different applications for which it is designed. The process of curing, however conducted, is only then regarded as complete and the tobacco fit for market after the leaf has undergone a supplemental process of fermentation, technically known as "sweating". This sweating occurs during the spring or summer following the curing proper. It is attended with elevation of temperature to 120° F., and results in essential modifications in the flavor and combustibility of the tobacco, and necessarily also in its chemical composition.

CONSTITUENTS OF THE TOBACCO LEAF.

The constituents hitherto detected in the leaf of the tobacco plant are as follows, viz:

NICOTINE ($C_{10}H_{14}N_2$).—A volatile oily substance, possessing a strong, acrid, tobacco odor. It is a powerful base, and forms well characterized compounds (salts), with the stronger acids. It is to this substance that the narcotic and toxical properties of tobacco are chiefly to be ascribed, especially when the leaf is chewed or the decoction is administered internally. When the tobacco is smoked, the nicotine is partly decomposed, and its decomposition products, together with those of the other constituents of the leaf, co-operate with the nicotine that sublimes unaltered to produce the physiological effects of the smoke.

Nicotine is present at a very early stage in the development of the tobacco plant. According to Nessler (*Der Tabak, seine Bestandtheile und seine Behandlung:* Mannheim, 1867, p. 12) it is present in the ribs and parenchyma of the leaves of the young plant when the leaves are only 1½ to 2 inches long. The following determinations by Nessler show the proportions present in leaves of different degrees of maturity:

	Percentage of nicotine in the *fresh substance.*	Percentage of nicotine in the *dry substance.*
1. Ribs of leaves 2 to 2½ inches in length	0.164	1.636
2. Parenchyma of leaves 2 to 2½ inches in length	0.379	2.840
3. Parenchyma of leaves 10¼ inches wide and 16 inches long	0.660	5.680
4. Parenchyma of leaves 3¼ inches wide and 8¼ inches long	0.225	1.495

The leaves marked No. 4 were the upper leaves from the same stalk that furnished the leaves marked No 3.

The foregoing results would show that the relative proportion of the nicotine increases with the age and development of the leaves. According to the same author, although the green leaves contain more nicotine than the fermented leaves, the nicotine odor is not perceptible in the former; it appears only after fermentation.

NICOTIANINE.—A volatile substance, of the consistence and appearance of camphor, possessing the odor of tobacco, and an acrid, aromatic, and bitter taste. According to the analysis of Barral (PELOUZE ET FRÉMY: *Traité de Chimie*, T. iv, p. 633), it possesses a composition in accordance with the formula $C_{23}H_{32}N_2O_3$. It is chemically an indifferent substance, forming no compounds with acids or alkalies, and is supposed to be the substance to which the characteristic odor and flavor of tobacco are chiefly due.

RESINOUS AND FATTY SUBSTANCES.—Tobacco contains a considerable proportion of resinous and fatty substances, concerning the nature of which as yet little is known. That the odor of the smoke is greatly influenced by these substances is more than probable, and this would appear to be especially true as regards the question of their resinous or fatty nature. The finely flavored tobaccos of Havana and Porto Rico are, according to Nessler (*op. cit.*, p. 29), richer in such substances than many European tobaccos, the smoke of which is strongly charged with the odor of burning fat, whence he infers that in the first named varieties the resinous substances are present in excess of the fats.

STARCH ($C_{36}H_{62}O_{31}$).—All tobaccos contain starch, usually in small proportions, although under certain conditions, as in the experiments of Schloesing (*Comptes-Rendus*, lxix, 253), the amount may rise to over 19 per cent. of the weight of the dry leaves.

SUGAR (glucose, $C_6H_{12}O_6$) is also present in the fresh (green) plant, usually in small proportions. When the tobacco is fermented in the operation of curing, the sugar usually disappears.

NITROGENOUS SUBSTANCES GENERALLY (ALBUMINOIDS).—Beside nicotine and nicotianine tobacco contains a large proportion of nitrogenous organic substances. Vauquelin (*Annales de Chimie*, lxxi, 139) found vegetable albumen in green tobacco, and his observations were confirmed by the investigations of Goupil (*Comptes-Rendus*, July, 1846, No. 1), made under the direction of Frémy, and by the analysis of Posselt and Reimann (*Pharm. Centralbl.*, 1847, 171). Tobacco that has become yellow or brown on drying, no longer contains the albuminous substance above noted. The nitrogenous substances extracted from harvested and dried tobacco are brown, and are to be regarded as the products of the more or less advanced alteration of the albuminous substances originally present in the green leaf. These brown nitrogenous substances approach closely in their properties to the (so-called) ulmic acid (PELOUZE ET FRÉMY, *op. cit.*, iv, 636).

PECTIC ACID ($C_{16}H_{22}O_{15}$, Frémy) occurs in varying proportions in tobacco, and gives strength and stiffness to the leaf. It has been generally assumed to exist in the tobacco in the state of calcium pectate.

CITRIC ACID ($C_6H_8O_7$), MALIC ACID ($C_4H_6O_5$) AND OXALIC ACID ($C_2H_2O_4$).—These acids are always present in tobacco, the first two in large, the last in small proportions. They exert a very important effect on the quality of the leaf.

ACETIC ACID ($C_2H_4O_2$) is present in varying, and usually small, proportions, and is either wholly or at least for the most part a product of fermentation.

NITRIC ACID (HNO_3) is present in certain cases in considerable quantity. According to Nessler (*op. cit.*, pp. 22 and 28) the presence of this substance in tobacco is to be ascribed, either wholly or in part, to the decomposition of other nitrogenous substances by fermentation with free access of air (nitrification). Reasons will be hereafter given which would appear to justify the opinion that this conclusion of Nessler's is erroneous, and that the nitric acid in tobacco has entered the plant through the processes of nutrition (absorption by the roots) during the period of its growth.

AMMONIA (H_3N) is present in all tobaccos, usually in small proportions. It is evidently a product of fermentative change. Nessler (*op. cit.*, p. 19) asserts that it does not occur in fresh (green) tobacco, and it is found to be evolved in large quantities during the fermentation of snuff. (PELOUZE ET FRÉMY, T. iv, pp. 654 *et seq.*)

CELLULOSE (CRUDE FIBER).—This material constitutes the frame-work or skeleton of the cellular tissue as distinct from the cell-contents. According to the proportion in which it is present, it bears a most important relation to the character of the leaf, as regards the texture, and, in the case of smoking tobaccos, the combustibility and general quality. According to Frémy (PELOUZE ET FRÉMY, T. iv, p. 647) the proportion is usually from 6 to 11 per cent. It is greatest in fine tobaccos of close texture and least in coarse tobaccos of thick tissue. According to Nessler (*op. cit.*, p. 29), the quality of tobacco (for smoking) improves to a certain extent as the proportion of woody fiber increases and that of the soluble organic (extractive) substances diminishes.

ORGANIC SUBSTANCES OF UNDETERMINED CHARACTER.—In addition to the substances previously enumerated, tobacco contains certain other substances, the nature of which has not been investigated. Among these are substances of a gummy consistence and indefinite chemical character, substances similar in properties to the humus substances, possibly also the decomposition products of tannin, which latter substance, while often present in the green leaf, is present only in faint traces in some of the less perfectly cured samples.

MINERAL INGREDIENTS (ASH).—The leaves of the tobacco plant are exceedingly rich in mineral ingredients, and the amount and nature of these is of essential influence on the quality of the material.

DISTRIBUTION OF THE DIFFERENT CONSTITUENTS IN THE PLANT.

From the investigations heretofore made concerning the distribution of the different constituents, it would appear that they are very unequally distributed throughout the different organs of the tobacco plant.

The results of Nessler have, as already stated, shown that nicotine is present in larger quantity in the substance of the leaves than in the ribs. Buchner (*Buchner's Repertorium*, xxxii, 38) found it in abundance in the seeds of the plant. In the leaves from plants grown under different conditions of soil, climate, and mode of cultivation, the percentage of nicotine varies greatly, as will be seen from the following analyses by Schloesing (*Ann. Chim. Phys.* [3] xix, 230):

PROPORTION OF NICOTINE IN LEAF TOBACCO, COMPUTED ON THE LEAF, DRIED AT 100° C.

Variety or source.	Percentage of nicotine.
Havana	2.00
Virginia	6.87
Kentucky	6.09
Maryland	2.29
Cigars (French, at 15 centimes)	2.00
Department Lot (French)	7.96
Department Lot-et-Garonne (French)	7.34
Department Nord (French)	6.58
Department Ille-et-Vilaine (French)	6.29
Department Pas-de-Calais (French)	4.94
Alsatia	3.21
Snuff	2.04

The amount of nicotine varies in different samples even among those from the same locality, and is influenced greatly by the character of the fermentation which the tobacco has undergone, as well as the length of time it has been kept, and the degree of exposure to which it has been subjected.

Nitric acid is very unequally distributed in the plant, being, as will be seen from the following table by Schloesing, (*Ann. Chim. Phys.* xl, 479), much more abundant in the midrib than in the substance of the leaf.

PROPORTION OF NITRIC ACID IN TOBACCO, COMPUTED ON THE LEAF, DRIED AT 100° C.

	Percentage of nitric acid in the leaf deprived of the midrib.	Percentage of nitric acid in the midrib.
FRANCE:		
Department Nord	1.49	5.00
Department Pas-de-Calais	1.74	5.99
Department Ille-et-Vilaine	0.48	2.10
Department Lot	0.60	2.08
Department Lot-et-Garonne	0.90	1.98
Alsatia	0.23	0.46
ALGIERS:		
Algérie des colons	0.74	6.10
Algérie des Arabes	0.14	1.04
EUROPE:		
Holland	2.00	5.12
Hungary (Szegedin)	0.39	3.11
Hungary (Debreczyn)	0.02	0.43
Macedonia	0.02	0.25
EXOTIC:		
Maryland	0.09	0.74
Kentucky	0.97	5.67
Havana	0.14	0.72
Brazil	0.08	1.80
Paraguay	1.80	4.70
Java	0.02	0.15

According to Schloesing, the percentage of nitric acid in the midrib diminishes as the latter contracts on approaching the apex of the leaf. The small lateral ribs contain nearly the same amount as the substance of the leaf. By the fermentation of tobacco, as in the manufacture of snuff, the percentage of nitric acid remains unchanged.

Pectic acid is contained in larger proportions in the ribs than in the substance of the leaves.

The mineral ingredients are distributed unequally in the different parts of the plant, as will be seen from the following table (PELOUZE ET FRÉMY, T. iv, p. 637):

PROPORTION OF ASH IN TOBACCO, DRIED AT 100° C.

	Per cent.
Leaves and ribs	17 to 24
Stalks	6 to 16
Roots	5 to 14

ANALYSES OF CERTAIN OF THE PRINCIPAL VARIETIES OF AMERICAN TOBACCO.

In Tables I, II, and III are given the results obtained in my analyses of samples of some of the principal varieties of American tobacco.

With the exception of No. 35, which was furnished by the producer, the samples were furnished by Colonel J. B. Killebrew, special agent for the investigation of the details of the cultivation and curing of tobacco. The samples were numbered and labeled as follows:

No. 3. Virginia tobacco. Sun-cured; for manufacturing plug tobacco.

No. 5. Virginia tobacco. Fire-cured; for the German and continental trade. Low grade.

No. 7. Tennessee tobacco. From Clarksville. Fire-cured; for the German and English markets. Gummy. Grown on rich, heavy loam, heavily manured.

No. 19. Kentucky tobacco (White Burley). From the Mason county district. Air-cured (in sheds, without artificial heat); for cutting or plug tobacco.

No. 10. North Carolina Yellow tobacco (Bright Wrapper). From Granville county. Grown on white or light gray sand.

No. 28. Louisiana tobacco. "Perique, cured in its juices." (Leaf deprived of midrib.)

No. 37. Louisiana tobacco. "Perique," air-cured. (Leaf deprived of midrib.)

No. 35. Connecticut Seed-Leaf. From New Milford. Grown on rich loamy soil, heavily manured. This sample was freshly cured, and had not undergone the "sweating" process.

No. 30. Connecticut Seed-Leaf. From Hartford, Connecticut. Grown on sandy soil.

No. 34. Pennsylvania Seed-Leaf. From Manor township, Lancaster county. Grown on a clearing, being the second crop after removing the timber. Eighty bushels of lime were used to the acre, but no manure.

No. 16. Ohio Seed-Leaf.

No. 22. New York State Seed-Leaf.

No. 25. Wisconsin and Illinois Seed-Leaf.

The details of the modes of curing and cultivation of these samples are fully set forth in the report of Colonel Killebrew. It is, however, desirable in this place to briefly recapitulate the leading features of the treatment to which the plants have been subjected, in so far as may be necessary for the correct interpretation of the results of the analyses.

Apart from the difference in character of the soil, the differences in the mode of cultivation between the different varieties relate chiefly to the length of time the plant is allowed to remain in the field after the "top" has been removed. As soon as the leaf ceases to expand, and the "granulation" due to the distension of the individual cells of the leaf through accumulation of intercellular substance begins, which, in good soil, and with favorable weather, will take place in from two to three weeks after "topping", the seed-leaf varieties are cut. The heavier tobaccos are, on the other hand, allowed to remain from four to six weeks before cutting, or, in the case of heavy shipping leaf (samples Nos. 5 and 7) until fully ripe and ready to decay.

Concerning the modes of curing: Sample No. 3 was cured by simple exposure to the sun on scaffolds. Samples Nos. 5 and 7 were cured by open wood fires in close barns, the heat being kept at or below 90° F. (32.2° C.) for two days, after which it was allowed to rise to 125° F. (51.6° C.) and then to 150° F. (65.5° C.), the last heat being continued for twenty-four hours, and the operation being complete in about four days and nights. No. 10 was cured by a very carefully regulated heat in close barns; the temperature being maintained for thirty-six hours at 90° F. (32.2° C.), and then carefully and systematically raised to 170° F. (76.6° C.), at which it remained for ten hours, the operation being complete in sixty to sixty-five hours, open coal fires or flues being used. Samples Nos. 19 and 37 and the seed-leaf samples (Nos. 35, 30, 34, 16, 22, and 25) were cured without artificial heat in sheds, ventilated by doors which are left open during the day, except in very damp weather, and closed at night.

From the foregoing it is evident that the samples Nos. 3, 5, 7, and 10 were cured with very little or no fermentation, whereas the other samples must have suffered considerable fermentative change. The process of curing, to which the sample No. 28 (Perique cured in its juices) was subjected, involves a very thorough and prolonged fermentation, with periodical applications of pressure, which last would tend to express the juices of the leaf from the cells and insure an exceedingly thorough and uniform fermentative process.

METHODS OF ANALYSIS EMPLOYED.

In preparing the samples for analysis, the leaves were exposed to the air at ordinary temperatures until thoroughly dry, the whole leaf, inclusive of the midrib, except Nos. 28 and 37, ground to fine powder and preserved in tightly stoppered glass bottles. The different determinations were then made on the air-dried leaf by the methods given below, and the results reduced to percentages in the substance, dry at 100° C.

1. MOISTURE.—Five grammes were dried for two hours in the air-bath at 100° C.

2. NICOTINE was determined in ten grammes by the method of Schloesing, as described by Grandeau (*Handbuch für Agricultur-chemische Analyse:* Berlin, 1879, p. 194), namely, by exhaustion with ether after making the sample strongly alkaline with ammonia, evaporation of the ether and titration of the residue with deci-normal sulphuric acid.

3. PECTIC ACID was also determined by the method of Schloesing, as described by Grandeau.

4. STARCH was determined in the residue from which the pectine substances had been removed by inversion to glucose by the method of Sachs (*Corr. Blatt d. Vereins analytischer Chemiker*, ii, 15, 21, and 25, and *Jour. Am. Chem. Soc.*, i, 546) and gravimetrical determination of the glucose with Fehling's solution, as described in the case of sugar.

5. SUGAR.—Ten grammes of tobacco were exhausted with 85 per cent. alcohol, the extract evaporated to remove the alcohol, the residue dissolved in water and made up to 500 cubic centimeters. One hundred cubic centimeters of the solution were then measured off, treated with excess of basic lead acetate, filtered, and the filtrate and washings of the precipitate brought to the volume of 200 cubic centimeters. The solution was then made alkaline with sodium carbonate, treated with a moderate excess of Fehling's solution and heated for twenty-five minutes to a temperature of 75° C. to 80° C. The cuprous oxide was then collected on a weighed filter and the equivalent of the precipitate in glucose calculated from the results of check determinations made under the same conditions with inverted cane sugar. A second portion of the original solution was then subjected to the process of inversion, after precipitation with lead acetate and treated as above with identical results—showing that no cane sugar was present.

6. NITRIC ACID was determined by exhausting the tobacco with 85 per cent. alcohol, evaporation of the extract, re-solution in water, and then proceeding by the method of Schultze (*Zeitschrift f. anal. Chemie*, 1870, 401); the error (a slight loss) incident to the method as originally described being compensated for by the addition to the solution under examination of a measured quantity of solution of sodium nitrate of known strength, the volume of gas yielded by the latter being deducted from the total volume obtained in the analysis. The graduated tube containing the soda solution was also caused to dip into mercury during the evolution of the gas, to prevent loss by the "churning up" of the gas with the liquid, and the attendant escape of small bubbles from the tube.

7. CITRIC, MALIC, OXALIC, AND ACETIC ACIDS were determined substantially by the methods of Schloesing, as described by Grandeau.

8. TOTAL NITROGEN was determined by the method of Dumas, and corrected by the results of "blank" combustions made under precisely similar conditions with pure sugar. In the case of the tobaccos which contained no nitric acid duplicate nitrogen determinations were made by the soda-lime method, with closely accordant results.

9. AMMONIA was separated from nicotine, and determined by the excellent method of Nessler (*op. cit.*, p. 144), namely, the ammonia was liberated with freshly ignited pure magnesia, distilled into dilute sulphuric acid, the solution carefully neutralized with sodium carbonate, and the nicotine precipitated with mercurio-potassic iodide. The liquid was then filtered, filtrate and washings treated with an excess of sodium mono-sulphide, the ammonia redistilled into deci-normal sulphuric acid, and the amount determined by titration.

10. RESINOUS AND FATTY SUBSTANCES.—The tobacco was exhausted, first with ether, then with absolute alcohol, the solutions evaporated to dryness, the residue digested with dilute sulphuric acid, thoroughly washed with water, dried at 100° C., and weighed.

11. CELLULOSE (CRUDE FIBER).—The determinations were made by the method described by Wolff. (*Chem. Untersuchung landwirthschaftl. Stoffe*, [3te *Aufl.*]: Berlin, 1875, p. 175.)

12. ALBUMINOIDS.—The figures under this heading were obtained by multiplying by 6.25 the residue left on deducting from the total nitrogen the nitrogen contained in the nicotine, ammonia, and nitric acid.

13. MINERAL INGREDIENTS.—The total percentage of mineral ingredients (ash) was determined by the method of Schloesing, as described by Grandeau (*op. cit.*, p. 6). The sample (10 grammes) was gently heated in a platinum boat in a porcelain tube, through which a slow current of carbonic acid was conveyed, until combustible gases ceased to be evolved. The combustion was then finished in a very slow current of oxygen, the tube being kept below a visible red heat during the whole experiment. The ash thus obtained was of about the same consistence as that of a cigar, no sign of fusion or "fritting" being observable, and was perfectly free from unburned carbon.

14. ASH ANALYSES.—The ash analyses, the results of which are given in Table II, were made substantially by the admirable method of Bunsen (*Annalen der Oenologie*, i, 3. See also Thorpe, *Ann. d. Chemie*, cxlix, 163). The phosphoric acid was separated from the insoluble ash by tin, as recommended by Bunsen, but the tin precipitate was not further treated for the determination of the phosphoric acid, as the latter was directly determined by the molybdate method of Finkener (*Berichte d. deutsch. Chem. Gesellsch.*, xi, 1638), in the second portion of the insoluble ash. The separations of potassium and sodium were made in duplicate, both by the platinic chloride and the indirect (chlorine) methods.

ANALYSES OF AMERICAN TOBACCOS.

TABLE I.—PERCENTAGE COMPOSITION OF TOBACCOS, DRIED AT 100° C.

Number of sample.	Variety.	Nicotine.	Resin and fatty substances.	Starch.	Glucose.	Albuminoids (N × 6.25).	Pectic acid (anhydride).	Citric acid (anhydride).	Malic acid (anhydride).	Oxalic acid (anhydride).	Acetic acid (anhydride).	Nitric acid (anhydride).	Ammonia.	Cellulose (crude fiber).	Sand.	Ash, exclusive of sand and carbonic acid.	Undetermined.	Total.
3	Virginia; sun-cured; for manufacturing plug tobacco.	3.26	4.15	5.80	6.89	16.09	6.19	2.12	5.02	0.84	0.42	0.00	0.33	9.58	0.55	12.41	26.26	100.00
5	Virginia; fired-cured; for the German and continental trade; low grade.	4.80	4.65	2.75	2.75	13.06	7.46	2.84	7.58	1.03	0.55	0.00	0.32	9.24	2.38	13.36	27.13	100.00
7	Tennessee, Clarksville; fire-cured; gummy; for the German and English markets; soil: heavy, rich loam.	5.29	4.99	3.54	0.00	16.54	6.01	2.99	5.51	1.30	0.89	1.55	0.98	9.68	2.25	14.37	24.01	100.00
10	Kentucky, Mason county; air-cured; for cutting or plug tobacco.	3.12	5.34	4.45	0.00	15.98	7.49	4.05	9.26	2.18	0.64	0.00	0.48	12.18	0.60	16.06	18.11	100.00
10	North Carolina, Granville county; bright wrapper; grown on white or light gray sand.	2.70	5.73	6.71	16.39	8.75	5.97	0.43	7.41	0.46	0.53	0.00	0.19	9.18	1.26	8.49	25.85	100.00
28	Louisiana "Perique" tobacco; "cured in its juices."	4.82	6.28	2.45	0.00	15.80	6.66	1.18	3.04	3.49	1.62	0.00	0.76	9.08	4.17	13.30	26.95	100.00
37	Louisiana "Perique" tobacco; air-cured.	4.25	7.26	2.79	0.00	16.50	7.43	4.31	7.90	2.06	0.28	1.05	1.05	8.30	0.76	15.54	19.32	100.00
35	Connecticut Seed-Leaf, New Milford; soil: rich loam.	4.06	4.20	3.22	0.00	18.09	6.29	5.80	10.09	0.92	0.31	3.23	0.65	10.61	1.34	15.10	16.00	100.00
30	Connecticut Seed-Leaf, Hartford; sandy soil	1.14	2.93	3.14	0.00	17.33	11.24	4.95	5.04	0.95	0.48	2.30	0.62	15.23	1.48	18.56	14.52	100.00
34	Pennsylvania Seed-Leaf; Lancaster county.	1.04	4.02	3.67	0.00	14.62	12.59	1.61	5.46	0.94	0.57	0.00	0.22	15.12	1.64	17.98	20.52	100.00
16	Ohio Seed-Leaf.	1.92	3.87	3.10	0.00	15.30	7.46	3.46	6.58	1.42	0.42	3.41	0.92	12.87	1.85	14.22	23.11	100.00
22	New York State Seed-Leaf.	2.85	3.02	2.63	0.00	16.26	9.89	4.42	8.27	1.11	0.41	2.20	1.20	12.15	1.94	15.50	18.56	100.00
25	Wisconsin and Illinois Seed-Leaf.	0.86	3.28	4.15	0.09	20.34	11.61	2.09	6.88	1.07	0.68	1.22	0.63	12.97	1.53	15.43	16.36	100.00

TABLE II.—ASH ANALYSES.

Number of sample.	Variety.	Total ash.	Ash, exclusive of sand and carbonic anhydride.	Potash.	Soda.	Lime.	Magnesia.	Ferric oxide.	Alumina.	Manganous oxide.	Phosphoric anhydride.	Sulphuric anhydride.	Silicic anhydride.	Chlorine.
3	Virginia; sun-cured; for manufacturing plug tobacco.	14.29	12.41	34.16	0.26	31.76	7.91	0.58	1.22	0.00	3.81	4.99	1.39	13.92
5	Virginia; fire-cured; for the German and continental trade; low grade.	17.42	13.36	26.55	0.22	36.96	11.51	0.95	1.81	0.00	3.23	4.27	3.20	11.21
7	Tennessee, Clarksville; fire-cured; gummy; for the German and English markets; soil: heavy, rich loam.	19.23	14.37	33.15	0.15	36.48	11.85	0.51	0.95	0.25	4.42	6.16	3.42	2.66
10	Kentucky, Mason county; air-cured; for cutting or plug tobacco.	21.85	16.06	39.51	0.86	39.80	5.34	1.56	0.51	0.13	6.09	4.52	1.20	0.48
10	North Carolina, Granville county; bright wrapper; grown on white or light gray sand.	11.19	8.49	41.56	0.47	28.12	9.78	0.59	0.29	0.11	5.23	4.53	2.75	6.57
37	Louisiana "Perique" tobacco; air-cured (leaf deprived of midrib).	19.82	15.54	30.23	0.25	37.47	12.43	1.19	0.72	0.29	6.18	6.10	1.91	3.14
35	Connecticut Seed-Leaf, New Milford; soil: rich loam.	21.08	16.30	35.08	0.01	40.38	11.33	1.47	0.74	0.13	3.20	4.08	1.39	2.10
30	Connecticut Seed-Leaf, Hartford; sandy soil.	22.92	18.56	41.30	0.26	28.70	7.56	2.13	0.83	0.00	3.26	3.34	1.00	11.58
34	Pennsylvania Seed-Leaf; Lancaster county.	24.74	17.98	49.60	0.36	28.55	8.18	1.30	1.05	0.00	5.72	2.61	1.05	1.49
16	Ohio Seed-Leaf	19.95	14.22	33.37	0.27	34.69	17.32	1.97	0.93	trace	4.29	3.48	3.07	1.51
22	New York State Seed-Leaf.	21.12	15.50	33.13	0.39	30.26	8.60	0.74	0.56	0.16	3.61	3.78	3.67	6.10
25	Wisconsin and Illinois Seed-Leaf.	20.81	15.43	38.71	1.08	33.40	12.57	0.79	0.74	trace	3.09	3.89	4.65	0.09

TABLE III.—PROPORTION OF MINERAL INGREDIENTS, TOTAL NITROGEN, AND POTASSIUM CARBONATE, IN 100 PARTS OF THE LEAF, DRIED AT 100° C.

No. of sample.	Variety.	Potash.	Soda.	Lime.	Magnesia.	Ferric oxide.	Alumina.	Manganous oxide.	Phosphoric anhydride.	Sulphuric anhydride.	Silicic anhydride.	Chlorine.	Total mineral ingredients.	Nitrogen.	Potassium carbonate.
3	Virginia; sun-cured; for manufacturing plug tobacco.	4.24	0.04	3.94	0.98	0.07	0.15	0.00	0.47	0.62	0.17	1.73	12.41	3.41	1.87
5	Virginia; fire-cured; for the German and continental trade; low grade.	3.55	0.03	4.94	1.54	0.12	0.24	0.00	0.43	0.57	0.44	1.50	13.86	3.21	1.41
7	Tennessee, Clarksville; fire-cured; gummy; for the German and English markets; soil: rich, heavy loam.	4.77	0.02	5.24	1.71	0.07	0.14	0.02	0.64	0.80	0.49	0.38	14.87	4.77	4.78
19	Kentucky, Mason county; air-cured; for cutting or plug tobacco.	6.84	0.14	6.39	0.86	0.25	0.08	0.02	0.98	0.73	0.19	0.08	16.06	3.40	8.25
10	North Carolina, Granville county; bright wrapper; grown on white or light gray sand.	3.53	0.04	2.39	0.83	0.05	0.03	0.01	0.44	0.38	0.23	0.56	8.49	2.03	4.21
37	Louisiana "Perique" tobacco; air-cured (leaf deprived of midrib).	4.71	0.04	5.82	1.93	0.18	0.11	0.04	0.96	0.96	0.30	0.49	15.54	5.16	4.29
35	Connecticut Seed-Leaf, New Milford; soil: rich loam.	5.30	trace	6.10	1.71	0.22	0.11	0.02	0.48	0.62	0.21	0.33	15.10	4.07	6.08
30	Connecticut Seed-Leaf, Hartford; sandy soil....	7.66	0.05	5.33	1.40	0.40	0.15	0.00	0.61	0.62	0.20	2.14	18.56	4.10	6.06
34	Pennsylvania Seed-Leaf; Lancaster county.....	8.92	0.06	5.13	1.47	0.25	0.10	0.00	1.03	0.47	0.19	0.27	17.98	2.70	11.01
16	Ohio Seed-Leaf..................................	4.75	0.04	4.93	2.46	0.15	0.13	trace	0.61	0.49	0.44	0.22	14.22	4.42	5.83
22	New York State Seed-Leaf.......................	5.13	0.06	6.09	1.33	0.11	0.09	0.02	0.56	0.59	0.57	0.95	15.50	4.59	4.86
25	Wisconsin and Illinois Seed-Leaf................	5.97	0.17	5.17	1.04	0.12	0.11	trace	0.48	0.60	0.72	0.15	15.42	4.23	7.83

PERCENTAGE OF NICOTINE IN THE PRINCIPAL VARIETIES OF AMERICAN TOBACCO.

In the following table are given the results of my determinations of nicotine on samples of the principal varieties of American tobaccos. In each case the air-dried leaves (including the midrib) were finely ground, and a careful average sample taken. The nicotine was determined on the air-dried sample by the method of Schloesing, and the percentage of moisture in a separate portion by drying at 100° C. The results are stated in percentages on the sample dried at 100° C.:

	Percentage of nicotine.
Virginia (heavily manured lots)..	5.81
Mexican Baler (heavily manured lots)..	5.60
Clarksville, Tennessee (heavily manured lots)..	5.29
Virginia (French Régie)..	4.81
Virginia (heavy English shipping)..	4.72
North Carolina Yellow ($50)..	4.58
German Saucer (Kentucky)..	4.55
Perique, cured in its juices (stripped from midrib)..	4.32
German, low grade (Virginia)..	4.30
Perique, air-cured (stripped from midrib)..	4.25
West Tennessee Stemmer..	4.23
German (dark)..	4.14
New York (Wilson's hybrid)..	4.14
Connecticut Seed-Leaf (New Milford)..	4.06
French Régie, A..	3.90
Pennsylvania Seed-Leaf..	3.88
Wisconsin Havana Seed..	3.82
Connecticut Seed-Leaf (Hartford)..	3.49
Pennsylvania Seed-Leaf (Lancaster county)..	3.47
Virginia sun-cured, for plug..	3.27
Perique air-cured (whole leaf)..	3.25
North Carolina Yellow ($65)..	3.15
Mason county, cutting or plug..	3.12
Ballard county, Kentucky, bright wrapper..	2.92
Owen county, Kentucky, plug fillers..	2.80
North Carolina bright wrapper..	2.69
Hart county, Kentucky, bright wrapper..	2.54
New York domestic Havana..	2.53
Florida Seed-Leaf..	2.38
New York State Seed-Leaf..	2.35
Connecticut Havana Seed..	2.21
Owen county, Kentucky, cutting leaf..	2.19
Ohio Seed-Leaf..	1.93
Sweet-scented Wisconsin and Illinois..	1.33
Connecticut Seed-Leaf..	1.14
Pennsylvania Seed-Leaf..	1.02
Wisconsin and Illinois Seed-Leaf..	0.86
Little Dutch (Miami valley)..	0.63

ABSORPTIVE CAPACITIES OF CERTAIN VARIETIES OF AMERICAN TOBACCO.

The capacity of leaf tobacco to absorb and retain different flavoring substances added in the form of "sauces" is a matter of great importance to the manufacturer, and especially to the foreign importer of American tobaccos. In the following table I have given the coefficients of absorption of some of the principal varieties used for the manufacture of chewing tobacco. These coefficients give the amount of water which each type will absorb and retain without dripping, expressed in multiples of the weight of the air-dried leaf; they do not, of course, represent the actual amount of water that a given sample will absorb and retain when subjected to the usual operations of manufacture. It may be safely assumed, however, that the results obtained in practice will stand to each other in a relation that will not vary greatly from that indicated by the theoretical coefficients of absorption, and the latter may, therefore, serve as a sufficient basis for classification and comparison.

The coefficients of absorption were determined as follows: The air-dried leaf was carefully weighed, moistened with water until it had become pliable, then loosely coiled on the bottom of a beaker and water enough added to completely cover it. The whole was then left at rest for 48 hours. The leaf was then taken out, suspended over the beaker until it had ceased to drip, and weighed. The liquid in the beaker was then evaporated to dryness on the water-bath, the residual extract dried at 100 C°., and weighed. The coefficient of absorption was determined from these data by the equation

$$\frac{a+b-c}{c}=x$$

wherein a is the weight of the wet leaf, b the weight of the dry extract, c the weight of the dry leaf, and x the coefficient of absorption. The results were as follows, viz:

	Coefficient of absorption.
German, low grade (Virginia)	2.88
North Carolina bright wrapper	2.77
North Carolina Yellow ($65)	2.65
Owen county, Kentucky, cutting leaf	2.60
Owen county, Kentucky, plug fillers	2.55
Hart county, Kentucky, bright wrapper	2.54
North Carolina Yellow ($50)	2.39
Ballard county, Kentucky, bright wrapper	2.27
Mason county, Kentucky, cutting or plug	2.21
Régie Virginia Shipper	2.14
German Saucer	2.07
Mexican Baler	2.04
Virginia sun-cured for plug	2.02
English Shipper (Virginia)	1.95
West Tennessee Stemmer	1.92
Virginia (heavily manured)	1.92
Florida Seed-Leaf	1.79
Perique, air-cured	1.74
Ohio Seed-Leaf	1.73
Sweet-scented Wisconsin and Illinois	1.67
Clarksville, Tennessee, German	1.48
Virginia French Régie, A	1.41
Virginia German Shipper	1.12

VARIATIONS IN THE COMPOSITION OF TOBACCOS REFERABLE TO CAUSES ATTENDING THE GROWTH OF THE PLANT.

These are of twofold character, being due in the first place to peculiarities of climate and soil, and secondly to the special methods of cultivation employed.

Concerning the immediate effects of climate, but little is known. It would appear, from the observations of Nessler, already cited, that the tobaccos of the tropics are richer in resinous substances, while those of the north in some cases contain a larger proportion of fat. It would also appear, from the existing analyses, that the northern tobaccos are generally richer in nicotine than those of southern climates. Nevertheless, in default of analyses of the *fresh* tropical tobaccos, it is impossible to say that this difference may not be chiefly due to fermentative change, attended with loss of nicotine by volatilization.

The effects of the character of the soil on the quality of the product have been much better studied. Thus the seed-leaf tobaccos of New England, which are specially prized on account of their fine texture, combined with strength and elasticity, and the entire absence of distinctive flavor, which might interfere with that of the cigar filling with which they are used as wrappers, are stated by Professor S. W. Johnson, in his admirable report on tobacco (*Annual Report of the Secretary of the Connecticut State Board of Agriculture*, 1873, p. 384), to be produced only on light, sandy lands, and he adds that "if upon these very heavy crops are obtained by extra manuring, the gain in quantity is offset by loss in quality". The peculiarities in chemical composition which especially distinguish these varieties are chiefly, as will be seen from the analyses on Table I, the larger proportion of cellulose, pectic acid, and mineral ingredients, and the smaller proportion of fatty or resinous substances and nicotine. The difference between the two samples of Connecticut Seed-Leaf, Nos. 30 and 35, is very marked. Sample No. 30, which was grown upon sandy soil, agrees closely in composition with the other seed-leaf varieties; whereas sample No. 35, grown on rich and heavily manured loam (see soil analysis No. 1), approaches in its large percentage of nicotine, relatively smaller percentage of cellulose, ash, and pectic acid, more closely to the "plug" than to the seed-leaf class.

Of all the samples analyzed, however, the sample of North Carolina "Bright Wrapper", No. 10, shows to the most surprising extent the influence of the character of the soil on the composition of the plant.

The soil on which this sample was grown was a light gray sand (see analysis, in Tables V and VI), containing, as shown by the analysis, a surprisingly small proportion of the mineral constituents available for the nutrition of the plant. On reference to the analysis on Table I, it will be seen that this tobacco contains little more than one-half of the average amount of mineral ingredients contained in the other samples, the deficiency being, as will be seen from Table III, especially noteworthy in the case of the lime, ferric oxide, and sulphuric acid. In the matter of proximate organic constituents, the tobacco is especially rich in carbo-hydrates, notably in glucose, which reaches the unprecedented figure of 16.39 per cent. Equally remarkable is the deficiency in albuminoids, which latter substances are present in little more than half of the average amount present in the other tobaccos.

The views at present generally obtaining regarding the physiological processes attending the growth of the plant, teach that the first organic substances formed in the leaves under the influence of light are the carbo-hydrates, starch, and glucose, and that these primary products are under the influence of the mineral ingredients absorbed from the soil, then transformed through further metamorphosis into secondary products such as organic acids, and with the co-operation of nitrogenous compounds (nitric acid and ammonia), also absorbed by the roots from the soil into the albuminoids and other nitrogenous constituents of the plant. The amount of nicotine in this sample is greater than in any of the seed-leaf varieties, excepting only the sample No. 35, a fact that would indicate that the small proportion of albuminoids is not due exclusively to deficiency in total nitrogen, but to the lack of those mineral constituents which are essential for the transformation of the nitrogen into albuminoids. Noteworthy in this connection is the deficiency in sulphuric acid, shown in Table III, a substance usually deemed prominent in the formation of the albuminoids.

It is of special interest in this connection to recall the results obtained by Schloesing (*Comptes-Rendus*, xlix p. 253), in his ingenious and beautiful experiments for the purpose of ascertaining the effects on the composition of the plant of the reduction of the absorption of mineral ingredients by the roots, by retarding evaporation from the leaves. Two tobacco plants, each of a dry weight of 8 grammes, were placed in pots. One pot was covered with a glass bell jar through which air was drawn at the rate of 500 liters in twenty-four hours. The plant in the other pot was left freely exposed to the air. The plants developed into a healthy growth and each produced twelve leaves. Plant No. 1, grown under the bell jar, possessed a dry weight of 48 grammes; plant No. 2, grown in the open air, a dry weight of only 37.4 grammes. For every liter of water evaporated there was, in the case of No. 1, 5.1, and in the case of No. 2 only 1.3 grammes increase of dry substance, while the gain in mineral substances in No. 1 was 3.6, and 5.1 grammes in No. 2. The results of the analyses of the plants obtained in these experiments are given in the following table:

TABLE IV.—ANALYSES OF TOBACCOS GROWN IN SCHLOESING'S EXPERIMENTS.

Percentage composition of leaves, dried at 100° C.

	Nicotine.	Oxalic acid.	Citric acid.	Malic acid.	Pectic acid.	Resin.	Cellulose.	Starch.	Albuminoids.	Ash.
No. 1, grown under the glass bell..........	1.32	0.24	1.91	4.68	1.78	4.00	5.86	19.30	17.40	9.41
No. 2, grown in the open air..............	2.14	0.66	2.79	9.68	4.86	5.02	8.67	1.00	18.00	15.26

Analyses of the ash of the whole plant.

	Total ash.	Ash, less sand and carb. acid.	Potash.	Soda.	Lime.	Magnesia.	Ferric oxide.	Phosphoric acid.	Sulphuric acid.	Chlorine.
No. 1, grown under the glass bell........	13.00	9.41	32.31	....	42.48	5.04	0.90	5.08	8.48	8.99
No. 2, grown in the open air..............	21.80	15.26	27.14	....	44.97	5.61	1.41	2.70	7.66	14.59

In the foregoing experiment the retardation of the evaporation of the water from the leaves of the plant under the bell jar was attended with a diminution in the absorption of mineral ingredients from the soil. The carbo-hydrates (in this instance starch), instead of undergoing transformation into other products, accumulated to an abnormal extent. The consequence was precisely similar in character to that resulting from the deficiency of mineral ingredients in the North Carolina tobacco (No. 10), only the accumulated carbo-hydrate in the last-named instance was sugar, whereas in the former instance it was starch, the difference in this respect being probably attributable to the difference in the other conditions of the experiment—among which perhaps the most noteworthy in this connection is the difference in the amount of albuminoids formed and in the percentage of sulphuric acid in the plant.

The differences in composition due to variations in the mode of cultivation are, apart from those arising from differences in manuring, chiefly to be referred to the greater or less length of time that the plant is allowed to remain in the field after it has been "topped". The operation of "topping", or removing the upper portion of the stalk, is designed to stop the further growth of the plant and to direct the whole vegetative energy to storing the cells already formed with the different organic substances, such as the organic acids, etc. The treatment of the seed-leaf and the smoking tobaccos in this respect is notably different from that to which the tobaccos destined for chewing are subjected. The former are allowed to remain on the stalk after "topping" until the expansion (*i. e.*, cessation of the growth of new cellular tissue, followed by "granulation", that is to say, distension of the individual cells from accumulation of cell-contents) commences, say two or three weeks, while the heavier shipping leaf is allowed to stand until fully ripe, *i. e.*, until the verge of decay is attained. During this period the increase in the cell-contents is very marked to the eye, by reason of the greater thickness of the leaf as well as in the granulation of the surface caused by the distension of the individual cells.

The leaf being in both cases allowed to remain on the stalk until the expansion of the leaf, *i. e.*, the formation of new cellular tissue ceases, it is evident that the larger proportional amount of cellulose in the seed-leaf varieties is due to a relatively more rapid production of ingredients other than cellulose in the other varieties during the period of growth subsequent to "topping" the plant. The smaller proportion of mineral ingredients, in spite of the fact that the chewing tobaccos are usually produced on soil rich in mineral plant-food, and the disappearance of the nitric acid, which is transformed into albuminoids and nicotine, would indicate that the removal of the "tops" has operated to diminish the absorption at the roots. That the nitric acid in the tobacco plant has entered through the process of absorption by the roots is clearly evident from the results obtained by Schloesing, and previously cited, which show that the nitric acid or nitrates are chiefly present in the midrib and in far smaller proportions in the substance of the leaf. This distribution is entirely inconsistent with the theory of Nessler (*op. cit.*, p. 28) that the nitric acid, as well as the ammonia, has resulted from the fermentative alteration of the albuminoids. In treating of the fermentation of tobacco it will be shown that while undoubtedly true of the ammonia, this theory is untenable in regard to the nitric acid. Meanwhile it may be mentioned that Nessler (*op. cit.*, p. 104) states that the total amount of nitrogen in the plant is greatest at the time of its strongest (most rapid) vegetation, *i. e.*, the middle of August, diminishes gradually from that time until the beginning of September, and then appears to remain constant until the point of absolute ripeness is attained or exceeded. The carbonate of potash in the ash increases until the middle of August, the period of strongest vegetation, and after that diminishes regularly until after the point of ripeness is attained.

CHANGES IN COMPOSITION OF TOBACCO INDUCED BY CURING.

According to the nature of the tobacco and the use to which it is to be applied, the operation of curing consists either simply in expeditious drying, with such precautions as may insure a regular progress of the operation and prevent the exudation of the juices which attends irregular and too rapid drying, or in drying preceded by or accompanied with fermentation.

As an instance of the first method may be mentioned the process of sun-curing, in which fermentation is probably reduced to a minimum. In the case of the methods of slower curing by carefully regulated artificial heat, a certain amount of fermentation probably takes place, although as shown by the large proportion of sugar retained by some tobaccos cured by this method, the fermentation must in these cases have been exceedingly slight, and probably restricted to those portions of the leaf that have been injured so as to expose the cell-contents to the air. The operation of slow curing by exposure to the air in barns or sheds is attended with a much greater fermentative change, accompanied by gradual oxidation, while the process of "curing in its juices"—to which Perique tobacco is subjected—represents a very thorough fermentation, with greatly reduced exposure to the air.

In order to understand the changes produced by fermentation, it is necessary to consider in detail the fermentative processes to which the different constituents of tobacco are liable.

1. SUGAR.—Of all the constituents of tobacco sugar is the most liable to change. As a rule the small quantities found in the green leaf disappear completely during the process of air-curing, so that it is generally stated that cured tobacco contains no sugar. While this is true of all of the air-cured samples analyzed, the sun-cured (No. 3) and fire-cured (No. 5) contain notable proportions, while in the case of the North Carolina yellow tobacco (No. 10), the carefully regulated drying by artificial heat has probably left almost the entire amount of sugar unchanged in the leaf.

2. CITRIC AND MALIC ACIDS.—These substances, especially in combination with bases are readily susceptible of fermentation. In the case of citric acid, Buchner (*Ann. Chem. Pharm.*, xxlviii, 208) found that under the action of ferments, alkaline citrates are gradually transformed, yielding first acetates, and subsequently carbonates of the alkaline base. Personne (*Comptes-Rendus*, xxxvi, 197) observed that crude calcium citrate (the juice of lemons neutralized with chalk) passes rapidly into fermentation, yielding acetic and butyric acids, and that the change is still more rapid when beer yeast is added.

Dessaignes (*Ann. Chem. Pharm.*, lxx, 102) observed the formation of succinic acid by the spontaneous fermentation of neutral calcium malate. Liebig (*ibid.*, lxx, 363) obtained the same results through fermentations produced by the addition of yeast or cheese in small proportions. If the temperature or the quantity of cheese exceed a certain degree or proportion, no succinic acid is formed, or that produced is immediately decomposed and there is produced butyric acid, some acetic acid and a colorless, volatile, oily substance possessing the odor of apples, the nature of which was not further determined, but which would seem to consist of the compound ethers of the acids formed in the fermentation.

3. ALBUMINOIDS.—These substances as a class, and in the moist state, are very susceptible to fermentative or putrefactive change. The only product of this decomposition that has been observed to form during the fermentation of tobacco is ammonia, which is evolved freely during the fermentation of tobacco for snuff. While undergoing such changes the albuminoids become active ferments. Pelouze (*Comptes-Rendus*, xliv, 118) has shown that in the absence of free mineral bases the decomposition of organic nitrogenous substances by fermentation or putrescence is unattended by the formation of nitric acid, but that, on the contrary, the nitrates, if already present, are decomposed with evolution of ammonia.

4. NITRIC ACID.—In spite of the fact just mentioned, and the additional fact communicated by Pelouze and Frémy (*op. cit.*, iv, 655) that the juice of tobacco, in a putrescent state, decomposes nitric acid, liberating nitrous oxide, it appears that nitric acid is not changed during the fermentation of tobacco. The following analyses made at the laboratory of the government tobacco manufactory at Paris show that even the prolonged fermentation to which snuff is subjected during the operations of manufacture does not cause any perceptible change in the proportion of nitric acid contained therein:

PROPORTION OF NITRIC ACID IN TOBACCO DURING THE DIFFERENT STAGES OF FERMENTATION FOR SNUFF.

Tobacco:	Per cent. of nitric acid.
Fermented in heaps	0.74
First fermentation in cases	0.73
Second fermentation in cases	0.70
Third fermentation in cases	0.72
Fourth fermentation in cases	0.72

5. OTHER CONSTITUENTS.—Concerning the other constituents of tobacco there is no evidence to show that they are liable to alteration during the processes of fermentation to which tobacco is subjected during the operation of curing.

Apart, therefore, from the destruction of sugar, it is manifest from the foregoing that the changes in composition attending the fermentation of tobacco must be restricted chiefly to the albuminoids and organic acids. The change in the albuminoids can only be observed in the general effect of fermentation on the quality of the tobacco, especially when used for smoking, and its extent is only measured to a certain degree by the evolution of ammonia and the attendant reduction in the percentage of total nitrogen. For the most part the albuminoids are transformed into substances of undetermined character, according to the statement of Pelouze and Frémy, already cited, substances similar to the humus bodies. That this change has an important effect on the quality is evident from the marked difference between the odor of the smoke of fermented and of unfermented tobaccos.

In the case of the organic acids (citric and malic acids) it will be seen from the foregoing that these acids are susceptible of several distinct species of fermentative change, of which the three following have been observed and studied:

1. Neutral calcium malate (Dessaignes and Liebig) is decomposed, with formation of succinic acid.
2. In presence of a large quantity of ferment, or in cases where the temperature is somewhat elevated, the fermentation yields only acetic and butyric acids, and a volatile substance of fruity odor (Liebig).
3. Alkaline citrates are transformed first into acetates, and finally into carbonates of the alkaline bases (Buchner), or they are transformed into acetates and butyrates (Personne).

In view of the fact that tobacco is very rich in albuminoids, which, when in a decomposing state form the most active ferments, the first species of fermentation of malic acid can hardly be supposed to occur. We have, therefore, to deal solely with the second and third cases.

The extent to which differences in composition may result from differences in kind and degree of fermentation in one and the same variety of tobacco is instructively shown by the two analyses of "Perique" tobacco; the one (28) "cured in its juices", the other (37) "air-cured". The sample "cured in its juices" contains but little over one-fourth of the citric acid, but one-half of the malic acid, and about six times the amount of acetic acid contained in the air-cured leaf. Details are not at hand concerning the length of time the plants were, in each of these cases, allowed to stand in the field after "topping", but the absence of nitric acid from the sample "cured in its juices" and its presence in the "air-cured" sample would lead to the inference either that the former had been allowed to remain longer in the field than the latter, or that the exceptionally prolonged and thorough fermentation had resulted in the destruction of the nitric acid originally present. The smaller proportion of ash would favor the first assumption.

In the case of the Perique tobacco "cured in its juices", therefore, we have manifestly an instance of the conversion of a large proportion of both the citric and the malic acids into acetic (and butyric) acid, and the agreeable fruity odor which this tobacco acquires during the fermentation, while partly due to these acids, would indicate the presence of substances similar to the volatile oil obtained by Liebig during the fermentation of malic acid. It is probable that this fermentation is similar in character to that which takes place whenever the drying of the leaf is retarded, and at the same time a moderate elevation of temperature is induced either spontaneously or through the cautious application of artificial heat. It will be observed that the increase in the acetic acid in the foregoing instance has not kept pace with the loss in citric and malic acids. This is no doubt partly due to the volatile character of the former and to the periodical exposure to the air to which the product is subjected during the curing.

In the case of tobaccos like the foregoing, intended chiefly for chewing purposes, the object of the fermentative part of the operation of curing is chiefly to produce or develop the flavor, and this is attained by the production of volatile acids, and probably of the ethers of these acids as above described. In the case of smoking tobaccos, the object to be attained is the improvement of the odor of the smoke and also the combustibility, on which moreover the former closely depends.

The fine aroma of good smoking tobacco is dependent on an exact regulation of the operation of combustion, so that a certain quantity of empyreumatic products may be formed and no more. It is hardly necessary to add that the nature of these products, as well as the quantity produced, depends upon the degree of completeness of the combustion. An absolutely complete combustion of tobacco produces only carbonic acid, water, and nitrogen, all absolutely inodorous substances. A simple destructive distillation of tobacco, without combustion, furnishes a mixture of liquid and gaseous products most offensive in odor even in the case of fine tobacco, and absolutely dissimilar from the perfume of the same tobacco when smoked. The operation of smoking tobacco, therefore, involves a nicely adjusted combination of destructive distillation and combustion. The more perfectly a tobacco burns the less odor it involves in burning; on the other hand, the slower and less perfectly it burns the stronger is the odor, until the point is reached when the odor becomes simply offensive and the tobacco becomes unfit for smoking.

The changes produced in the operation of curing smoking tobacco, must therefore be effected primarily with a view to modifying or, as uncured tobacco is always imperfectly combustible, to increasing the combustibility.

CAUSES UPON WHICH THE COMBUSTIBILITY OF TOBACCO DEPENDS.

Schloesing (*Comptes-Rendus*, l, 642 and 1027), to whom more than to any other investigator we are indebted for our present knowledge regarding the chemistry of tobacco, first pointed out in the year 1860 the existence of a connection between the "combustibility" of tobacco (*i. e.*, the property it possesses of remaining incandescent, glowing for some time after being ignited) and the percentage of potassium carbonate it yields on incineration. The conclusions attained by this author are as follows:

1. The soluble part of the ash of a combustible tobacco always contains potassium carbonate (tobacco contains, according to Schloesing, no sodium); or, in general, a tobacco is the more combustible the more alkaline the ash.

2. The soluble part of the ash of a difficultly combustible tobacco contains no potassium carbonate; it ordinarily contains lime, whence it follows that in combustible tobaccos the quantity of potash exceeds in equivalent proportion that of the sulphuric acid and chlorine, and that in difficultly combustible tobaccos the reverse is the case.

3. A difficultly combustible tobacco becomes combustible if the potassium salts of an organic acid (malic, citric, tartaric, oxalic, etc.) be added thereto in such quantity that the potash in the ash exceeds in equivalent porportions the sulphuric acid and chlorine.

4. A combustible tobacco becomes difficultly combustible if a mineral salt (sulphate or chloride of calcium, magnesium, ammonium, etc.) be added in such quantity that the sulphuric acid and chlorine exceed in equivalent proportions the potash in the ash.

Schloesing finds that while the presence of nitrates promotes the combustibility to a certain extent, their value is only secondary. Very combustible tobaccos have been found to be very poor in nitrates, while other, quite difficultly combustible tobaccos, were rich in nitrates.

Schloesing gives the following explanation of the results of his observations on the foregoing subject:

I have observed that the alkaline salts of malic, citric, oxalic, pectic, and tartaric acids, when heated in close vessels, swell up strongly, without doubt because they melt in decomposing, and leave a very voluminous coal that possesses little solidity and is very porous; while the lime salts under the same circumstances do not alter in volume, and leave a very compact and coherent coal. Now, every one knows that a porous coal remains longer incandescent than a compact one. On the other hand, if we examine the combustion of tobacco, *e. g.*, a cigar, we will observe that the action of heat produces two classes of effects. Volatile substances (smoke) and coal are formed, which latter chiefly sustains the combustion, as it burns out as it forms. If a cigar contains enough of those salts which, when ignited, swell up while decomposing, it will leave a porous coal, throughout which the other substances of the tobacco are finely distributed, and will consequently "hold fire" for a long time. If, on the other hand, the cigar contains little or no organic potash salt, but only sulphate or chloride, neither of which plays any rôle in the combustion, and if the malic, citric, etc., acids are combined with lime, the constituents of the tobacco do not swell up in burning, but leave a compact coal which does not long remain incandescent. In the latter case the cigar carbonizes, and the resulting coal still shows the structure of the leaf.

I will not say that in a difficultly combustible tobacco there are no organic potash salts, that all the potash is in the form of sulphate and chloride, but only that the combustibility of tobacco is independent of its thickness, porosity, ripeness, and composition. A tobacco, therefore, burns well if it contains enough organic potash salts; it burns badly or not at all if it contains too little, and the presence of carbonate of potash in the ash is a sign of the good combustibility of tobacco, as its absence is a sign of incombustibility.

The connection between the presence of carbonate of potassium in the ash and the combustibility of tobacco was also observed by Nessler (*op. cit.*, p. 32, *et seq.*) almost simultaneously with Schloesing. While the results obtained by him tend in general to show, in accordance with those of Schloesing, that the ash of "combustible" tobacco always contains a notable proportion of potassium carbonate, he has found, by quantitative determinations, that the combustibility is not so strictly proportional to the amount of potassium carbonate in the ash as Schloesing has assumed, at least not when comparison is instituted between tobaccos of different origin. Among the conditions that influence combustibility he mentions that tobacco containing larger quantities of albuminoids and fat may leave a difficultly combustible coal that will only then burn when much potash is present; and, on the other hand, that those tobaccos burn best that contain the most woody fiber.

Concerning the explanations of Schloesing in regard to the nature of the effect exerted by potassium carbonate in the ash, or rather by the substances that leave potassium carbonate on incineration, on the combustibility of the tobacco, Nessler mentions the following objections, based in part on his own observations and experiments:

First. In the case of slips of paper, as well as those of tobacco, the combustibility is essentially promoted by saturating them with carbonate or sulphate of potassium. A formation of organic potassium salts is in this case only possible when tobacco is impregnated with potassium carbonate, but not when the paper is so treated, and not when tobacco is treated with potassium sulphate.

Second. A swelling up of the coal behind the incandescent part, such as Schloesing assumes, is a sign of a bad and not of a good tobacco.

Third. Acetates of the alkalies do not swell up, or at least hardly do so, and nevertheless promote combustibility like the carbonates.

It will be observed that the authorities just cited admit two conditions as conducive to the perfect combustibility of tobacco, namely:

1. The presence of a notable proportion of potassium carbonate in the ash. (Schloesing–Nessler.)
2. The presence of a large proportion of woody fiber in the tobacco. (Nessler.)

Concerning these points it is to be observed that the presence of a larger proportion of woody fiber is equivalent to the presence of a smaller proportion of the other constituents of the leaf, and on reference to the analyses on Table I it will be seen that the seed-leaf varieties are especially rich in cellulose (crude fiber), while the chewing varieties, with the sole exception of the Kentucky tobacco, No. 19, are relatively poor therein.

Concerning the presence of potassium carbonate in the ash, it will be seen from Table III that great variations exist in the amounts yielded by the different samples, but that the seed-leaf varieties yield more potassium carbonate than the others, with the sole exception of No. 19. But among the seed-leaf varieties themselves the amount of carbonate of potash furnished on incineration does not stand in any simple relation to the combustibility, as will be seen from the following instances in which the combustibility was determined by the method of Nessler (*op. cit.*, p. 65): Pieces 1 to ½ inch wide were cut from the middle of each leaf, running from the edge to the midrib and avoiding the lateral ribs. These were pressed flat by gentle pressure after slight moistening, and exposed to the air for forty-eight hours. The strips were then ignited on the end, and the lapse of time noted between the first ignition and the extinction of the spark or glowing edge; the burnt edge was then removed with the scissors and the slip reignited, the operation being repeated until the whole slip had been burned from the edge to the midrib; the mean of the observations for the whole slip was then taken. When six slips had been burned, the maximum, minimum, and mean of the series were noted. The results of these tests, while showing great diversities in the combustibility of even different leaves from the same sample, were nevertheless in a measure characteristically distinct for the different brands.

Especially interesting were the results obtained with the samples of Connecticut Seed-Leaf, viz: No. 30 (Hartford), burned to end of strip 120–160 seconds; No. 35 (New Milford) maximum 16.0, minimum 2.7, mean 7.8 seconds. As will be seen from Table III, these samples yielded, on incineration, the same percentage of potassium carbonate. The percentage of cellulose is greater in No. 30; the percentage of citric and malic acids is greater in No. 35. This latter fact would suggest that a difference in the character of the organic salts, and especially a difference in the relative proportions of acids and bases therein, might have something to do with this marked difference in combustibility. As we are still ignorant of the modes of combination in which the mineral ingredients exist in the plant, and as we are still in uncertainty as to the chemical character (whether acid or indifferent) of the hitherto unstudied constituents of the leaf, it is not possible to say, with any certainty, from the results of the analysis, or even from the examination of the extracts or decoctions of the plant, precisely in what state of combination the constituents may have existed in the interior of the vegetable cell. Nevertheless, it is of some interest to compare the respective equivalence of the acids and bases found in the analysis with a view of ascertaining if this proportion bears any relation to the combustibility of the leaf. The equivalence is obtained by dividing the percentage of each ingredient by its molecular weight and multiplying the quotient by the atomicity. If we then deduct from the sum of the equivalents of the inorganic bases the sum of the equivalents of the inorganic acids of the ash, we have as the residue the equivalence of the inorganic bases (potash, soda, lime, etc.), that are to be compared with the organic acids and nitric acid of the plant. The equivalent ratio therefore expresses the relative equivalence of the organic acids and nitric acid (taken as unity) with that of the inorganic bases with which these acids may be supposed to be combined. Applying this process to samples Nos. 30 and 35, we have:

Nos. of samples.	Equivalent ratios.
30	Organic and nitric acids : Bases=1 : 1.345
35	Organic and nitric acids : Bases=1 : 0.970

From the foregoing it will be seen that the sample No. 30 contains a large excess of bases over the amount requisite to form neutral salts with the acids named above, or, in other words, the quantity of mineral bases in the sample No. 30, after deducting the amount required to form neutral salts with the inorganic acids of the ash, is about one-third greater than is required to form neutral salts with the organic acids and nitric acid of the leaf; whereas in the sample No. 35 the proportion of bases is less than is required to form neutral salts.

In this and the following calculations, both ammonia and nicotine are omitted, as on account of the volatility and readily decomposable character of the organic salts of these bases, and their relatively small amount, they cannot be supposed to materially affect the combustibility of the tobacco. Nitric acid has been included with the organic acids, for the reason that it is readily decomposed in contact with organic matter, and at a low heat, and, like the organic acids, leaves the base with which it was combined in the state of carbonate.

On the following table are given the equivalent ratios, proportions of potassium carbonate, and, for comparison, also the proportions of nitric acid, together with the results of the burning tests, for sample No. 37 and the different seed-leaf varieties:

RELATIONS BETWEEN EQUIVALENT RATIOS AND BURNING QUALITIES.

Number.	Nitric acid.	Potassium carbonate.	Equivalent ratios.	Burning tests.
			Acids. *Bases.*	*Max.* *Min.* *Mean.*
37	1.65	4.30	1 : 1.005	3.0 2.0 2.4 seconds.
35	3.23	6.08	1 : 0.970	16.0 2.7 7.8 seconds.
30	2.39	6.06	1 : 1.345	To end of strip, 120 to 160 seconds.
34	0.00	11.91	1 : 1.763	To end of strip, 110 to 120 seconds.
16	3.41	5.83	1 : 1.160	To end of strip, 80 to 230 seconds.
				Max. *Min.* *Mean.*
22	2.29	4.86	1 : 0.978	Dark.....15.6 8.4 12.2 seconds. Medium..66.8 34.7 46.0 seconds. Light..To on of strip, 140 seconds.
				Max. *Min.* *Mean.*
25	1.22	7.83	1 : 1.336	106.5 44.5 71.3 seconds.

The results communicated on the foregoing table show unmistakably the existence of a relation between the combustibility and the relative proportions of acids and bases present in the leaf. In general, those samples burn best wherein the excess of bases is most marked, and it will be seen that the relative combustibility is independent of the proportion of potassium carbonate the leaf yields on incineration, and, to a large extent, of the proportion of the nitric acid; nevertheless, the effects of the latter are quite apparent in the sample No. 16. In Nos. 25 and 30, while the equivalent ratios are nearly equal, the degree of combustibility—although both burn well—is quite different, possibly owing to the much larger percentage of albuminoids in No. 25. Sample No. 22 was composed of leaves of very diverse appearance, mostly dark in color, but sometimes light. One leaf, however, was very light and thin, and this specimen, as stated, burned to the end of the strip. The reactions of the aqueous extracts of these samples to test papers were as follows: No. 35, acid; Nos. 16, 22, and 37, neutral; Nos. 25, 30, and 34, alkaline. No. 34 was strongly alkaline.

The foregoing results would appear to indicate that the rational conduct of the operation of curing smoking tobaccos, and especially the seed-leaf varieties, would involve the destruction of a larger proportion of the organic acids (citric and malic acids) by fermentation, the operation being in some instances carried to the extent of transforming the salts of these acids, in part, into carbonates. It is hardly necessary to say that this operation would result in setting free a large proportion of the nicotine, which would volatilize during the process.

Nessler (*op. cit.*, p. 138), to improve the combustibility of tobacco, recommends that it should be moistened with a solution of acetate, or better, carbonate of potassium, adding "the best result was always obtained with an aqueous solution of potassium carbonate".

While it is quite conceivable that a marked improvement should be attained by adding potassium acetate to tobacco containing an excess of citric or malic acids, inasmuch as these acids would displace the acetic acid, it is improbable that any good result should accrue from the addition of alkaline citrates or malates on the general principle of increasing the percentage of organic salts in the tobacco, inasmuch as it is evident from the foregoing results that an increase in the absolute amount of citric and malic acids has a disadvantageous effect on the combustibility of the tobacco.

ANALYSES OF TOBACCO SOILS.

These analyses of soils were made on samples from: First, the Housatonic valley, at New Milford, Connecticut; second, the Clarksville district, Montgomery county, Tennessee, which produces the best variety of "shipping" or "export" tobacco; and third, Granville, North Carolina, where the best variety of the North Carolina Lemon Yellow tobacco is grown. The two samples last named were furnished by Colonel Killebrew, and, according to him, are fairly representative specimens of the best varieties of these respective soils. The first sample was taken by myself at New Milford, from a field which, according to my informant (Mr. Isaac B. Bristol), produces the best quality of Housatonic Valley Seed-Leaf tobacco.

The general character of the samples was as follows:

No. 1. *New Milford, Connecticut.*—Hill soil. Rich, dark loam, somewhat sandy in character. Average depth, about 12 inches, with loamy subsoil extending to the bed-rock (gneiss). Geological character of the surrounding rocks: Granite, gneiss, and mica, and hornblende slates. The rock fragments found in the sample were chiefly granite, quartzite, mica slate, and, more rarely, hornblende slate. The field had been under cultivation six years, exclusively on tobacco. Average yield, 1,500 to 1,800 pounds (dry weight) per acre of tobacco of fine quality. Manured in the spring with 20 cart-loads of barnyard and stable manure per acre. The sample was taken November 30, 1880. The last application of manure was in the spring of the same year.

No. 2. *Clarksville, Montgomery county, Tennessee.*—Virgin soil. Rich, dark, clayey loam. Average depth 5 to 6 inches. Incumbent upon a highly ferruginous clay, the latter being intercalated with beds of chert, varying from 1 to 3 feet in thickness. According to Colonel Killebrew this soil belongs, geologically, to the Lithostrotian bed of the Siliceous group of the Lower Carboniferous formation. The small quantity of rock fragments contained in the sample consisted chiefly of highly decomposed feldspar. The land adjoining the woods where this sample was taken, produced, when first opened, 1,500 pounds of most excellent tobacco per acre, and has continued to produce it, in rotation with wheat and clover, for twenty-two years, with but little diminution in fertility. The Clarksville tobacco, marked No. 7 on the schedules of tobacco analyses (Tables I to III), is, according to Colonel Killebrew, fairly illustrative of the character of that produced upon this soil.

No. 3. *Granville, North Carolina.*—Light, gray sand, with porous cream-colored subsoil. According to Colonel Killebrew this soil belongs to the Laurentine series of the Archæan age, and is derived from granitoid rocks and quartzites. Numerous trap or intrusive rocks are found in the vicinity, but the soil arising from the disintegration of these will not produce the yellow tobacco, nor does this tobacco attain a high degree of excellence on soils containing much ferric oxide. When the subsoil is red or clayey, heavy tobacco will grow, but not the yellow leaf. The rock fragments found in the sample consisted chiefly of quartz. The field from which the sample was taken had been used for tobacco for six years in succession, but was previously an "old field" that had been exhausted by long cultivation and allowed to lie untilled for some 14 years previous to being used for tobacco, and had become covered with "old-field pines" (*Pinus tæda*, Michaux), persimmon bushes, etc. Concerning the manuring to which this field was subjected, I quote the following from Colonel Killebrew: "The soil is simply a sponge, into which just enough fertilizing matter is put to bring the plants to the proper size, and no more."

METHODS OF ANALYSIS.

1. MECHANICAL ANALYSIS.—In the mechanical analysis of soils, which operation has for its object the separation of the particles of the soil according to their size and the determination of the proportional quantity of the particles of different sizes, the following method was adopted, viz:

The whole sample was first passed through a sieve of perforated metal having holes of 3 millimeters in diameter. The weight of the particles remaining on the sieve was then determined and also that of the portion passing through the sieve ("fine earth"). The last-named portion constituted the material for all of the subsequent operations of mechanical and chemical analysis.

Thirty grammes of the "fine earth" were boiled out repeatedly with water, as recommended by Wolff (*Chem. Untersuchung landwirthschaftlicher Stoffe*: Berlin, Wiegant & Hempel [3te Aufl.], 1875, p. 4), until the lumps were disintegrated and the clayey portions separated from the sand. The material was then successively washed through perforated metal sieves, the holes in which were respectively 1^{mm}, 0.5^{mm}, and 0.25^{mm} in diameter. The portions retained on the sieves were severally dried, ignited and weighed, and the finest portion, or that passing through the 0.25^{mm} sieve was then submitted to the following process of separation, which is based upon the method of Knop, as described by Wolff (*op. cit.*, p. 10), but perfected by the employment of the principle of fractional separation.

The sediment and water passing through the 0.25^{mm} sieve were placed in a glass cylinder 53 centimeters long and 37^{mm} in internal diameter. The cylinder was closed at the bottom and was provided with a lateral tube inserted 6 centimeters above the bottom. Three other lateral tubes were inserted at intervals of 10 centimeters above the first tube, and a ring was etched into the cylinder 10 centimeters above the uppermost tube. The lateral tubes were closed with rubber tubes compressed by spring clips. The sediment being placed in the cylinder, water was added to the mark or ring, the cylinder closed with a rubber stopper, and vigorously shaken until the contents were thoroughly mixed. It was then placed upright, the stopper removed, and after standing undisturbed for five minutes the clip on the uppermost tube was opened and the water allowed to flow into a beaker. After five minutes further standing, the second clip was opened and the water drawn off into the same beaker; in the same manner the water was drawn off from the other tubes at intervals of five minutes until the level of the lowest tube was reached. The cylinder was then refilled with water to the mark, thoroughly shaken after inserting the stopper and the water again drawn off at intervals of five minutes, as before; the operation being repeated until the water drawn off was almost free from turbidity. The sediment remaining in the cylinder from this process of washing by subsidence is termed by Knop "fine sand", the material flowing off in suspension in the washing waters "dust", and the process of separation by Knop's original method ends here.

A little reflection will show that as far as a separation into particles of definite size is concerned, the foregoing method is very imperfect. While the repeated agitation of the sediment from each washing with fresh additions of water tends to remove the objection noted by E. W. Hilgard (*Silliman's Journal*, 1873, [3] vi, 288, 333) in his admirable paper on silt analysis, and to which all methods of continuous washing known previous to the invention of the method of Hilgard were subject, viz, the tendency of the particles of clay to ball together and sink with the coarser particles even in opposition to upward currents of water, it is nevertheless attended with the following defect to which Hilgard's method is also liable, and which, as far as the author is aware, has not hitherto received sufficient attention. In the case of a quiescent body of water containing suspended sediment, the particles of the latter sink to the bottom with varying degrees of rapidity, proportional to their size and specific gravity, or, as the mineral constituents of soils do not, for the most part, differ very greatly among themselves in specific gravity, chiefly proportional to their size. In course of their descent, however, the more swiftly descending particles collide with the more slowly descending, or, as we may say, "lighter" particles. The rate of descent is therefore influenced not only by the relative size of the particles of suspended matter, but also by the number and force of these collisions. These two last-named conditions vary according to the difference in size (and specific gravity) of the particles and also according to the relative number of the particles of each different size. It is evident, therefore, that the error arising from the cause just mentioned is not constant, but that it must vary in amount according to the specific character of each sediment, and that the results of separations by simple subsidence can never afford a basis for an exact comparison in the matter of the state of subdivision of sediments of diverse origin and differing in the relative proportions of the particles of the different sizes. The conditions above instanced as obtaining in the case of a subsidence from a liquid in a quiescent state, obtain with equal force in the case of subsidence from slowly moving upward currents, and undoubtedly constitute a source of material error in all methods of mechanical analysis by continuous subsidence.

In the method pursued by the author the defect above noted was obviated by the following means:

The "fine sand" from the first series of subsidences was placed in a separate vessel, the washings were allowed to remain undisturbed for twelve hours, the turbid liquid decanted off, and the sediment returned to the cylinder. Water was then added to the mark, the whole shaken up, and the liquid drawn off at intervals of five minutes, as in the first series. The sediment from this operation was placed in a separate beaker, the liquid "washings" returned to the cylinder, and again subsided as before; the sediment from this second subsidence was added to that from the preceding operation and the washings again returned to the cylinder, the operation being repeated as long as any sediment could be obtained from renewed treatment of the washings; the final washings were then placed in a separate vessel for subsequent microscopic measurements.

The collective sediments from the last series of operations were then returned to the cylinder and subsided with fresh additions of water, as in the case of the first series; the "fine sand" thus obtained being added to that from the first series, and the washings being collected in a large beaker. The latter were left at rest for twelve hours, and the sediment returned to the cylinder and treated as before until no further separation could be effected. The "fine sand" resulting from all of these operations was then dried, ignited, and weighed; the weight of the portion removed by the washing being determined by difference, as it was, owing to its excessively slow rate of subsidence, found impracticable to collect it for direct weighing. The size of the particles of "fine sand" was then determined by micrometric measurement, and was found to vary from 0.25^{mm} to 0.009^{mm} average diameter. Similar measurements were made on the material obtained by long subsidence from the washings from the foregoing operations, with the result of showing that the average diameter of the largest particles did not exceed 0.01^{mm}.

The results of the foregoing processes of mechanical analysis were then computed in percentages on the ignited soil, and are given in the following table:

TABLE V.—MECHANICAL ANALYSES OF TOBACCO SOILS.

[Computed in percentages on the ignited soil.]

	New Milford, Connecticut.	Clarksville, Tennessee.	Granville, North Carolina.
Particles larger in diameter than 3.0mm	8.55	0.32	0.23
Particles of diameter from 3.0mm to 1.0mm	4.96	0.45	15.04
Particles of diameter from 1.0mm to 0.5mm	4.43	0.96	33.43
Particles of diameter from 0.5mm to 0.25mm	11.86	1.25	18.82
Particles of diameter from 0.25mm to 0.01mm	60.54	61.58	23.59
Particles smaller in diameter than 0.01mm	9.66	35.44	8.89
Total	100.00	100.00	100.00

2. CHEMICAL ANALYSES.—The chemical analyses of the "fine earth" embrace analyses of the extracts obtained by treating, first, the air-dried soil with cold hydrochloric acid; second, with hot hydrochloric acid; third, by treating the residue insoluble in hot hydrochloric acid with sulphuric acid, and analyses of the residues insoluble in sulphuric acid. The acid extracts were prepared according to the directions of Wolff (*op. cit.*, p. 12 *et. seq.*), and the analyses were made substantially according to the method of the author in question, with the exception of the analyses of the residues insoluble in sulphuric acid, which were made by the usual method of silicate analyses (fusion), the alkalies being determined by the method of Professor J. Lawrence Smith.

The results of the analyses are given in the following table, in which the method of Wolff has been in so far departed from that the horizontal columns of figures headed "soluble in hot hydrochloric acid", in lieu of representing the total substances extracted from the air-dried soil by hot hydrochloric acid, represent the constituents soluble in hot but insoluble in cold hydrochloric acid, while the horizontal columns headed "total" and printed in heavy type represent the percentage composition of the air-dried soils irrespective of the degree of solubility of the constituents.

TABLE VI.—CHEMICAL ANALYSES OF TOBACCO SOILS.

	Moisture (100° C.).	Organic and volatile substances.	Silicic anhydride in solution.	Silicic anhydride soluble in sodium carbonate.	Ferric oxide.	Alumina.	Manganous oxide.	Lime.	Magnesia.	Potash.	Soda.	Phosphoric anhydride.	Sulphuric anhydride.	Total.
NEW MILFORD, CONNECTICUT.														
Moisture at 100° C	1.8200													1.8200
Organic and volatile substances		6.8600												6.8600
Soluble in cold hydrochloric acid			0.0535	(?)	3.1493	3.4699	0.0173	0.2830	0.7647	0.1801	0.0074	0.1984	0.0378	8.1623
Soluble in hot hydrochloric acid			0.0724	4.2426	0.3833	1.2909	0.0000	0.0404	0.0205	0.0403	0.0072	0.0218	0.0378	6.1722
Soluble in sulphuric acid			0.0000	1.0188	0.0326	2.6121	0.0000	0.1630	0.0738	0.3767	0.0027	0.0000	0.0000	4.2797
Insoluble in acids			59.9632		0.8540	7.4694	0.0000	1.3658	0.4302	1.3155	1.5432	0.0749	0.0000	73.0162
Total	**1.8200**	**6.8600**	**65.3505**		**4.4132**	**14.8513**	**0.0173**	**1.8531**	**1.2892**	**1.9246**	**1.5605**	**0.2951**	**0.0756**	**100.3104**
CLARKSVILLE, TENNESSEE.														
Moisture at 100° C	1.3500													1.3500
Organic and volatile substances		4.3450												4.3450
Soluble in cold hydrochloric acid			0.0338	(?)	1.5800	1.4006	0.0873	0.2270	0.1218	0.0445	0.0018	0.0711	0.0105	3.5784
Soluble in hot hydrochloric acid			0.0608	3.2398	0.3167	1.8001	0.2164	0.0680	0.0714	0.0730	0.0013	0.0105	0.0009	5.8649
Soluble in sulphuric acid			0.0000	2.7239	0.1701	3.3385	0.0000	0.0547	0.0951	0.2561	0.0281	0.0000	0.0000	6.6065
Insoluble in acids			73.8330		0.3635	2.2123	0.0000	0.2772	0.1020	1.6484	0.2654	0.0567	0.0000	78.7585
Total	**1.3500**	**4.3450**	**79.8973**		**2.4303**	**8.7515**	**0.3037**	**0.6269**	**0.3903**	**2.0220**	**0.2966**	**0.1383**	**0.0114**	**100.5633**
GRANVILLE, NORTH CAROLINA.														
Moisture at 100° C	0.6650													0.6650
Organic and volatile substances		1.2050												1.2050
Soluble in cold hydrochloric acid			0.0066	(?)	0.1775	0.3523	0.0052	0.0533	0.0098	0.0115	0.0033	0.0203	0.0090	0.6488
Soluble in hot hydrochloric acid			0.1299	0.7921	0.2115	0.4737	0.0365	0.0174	0.0128	0.0046	0.0012	0.0000	0.0050	1.6847
Soluble in sulphuric acid			0.0000	0.3818	0.1542	0.8957	0.0000	0.0305	0.0044	0.0767	0.0016	0.0000	0.0000	1.5440
Insoluble in acids			92.1931		0.0843	0.7748	0.0000	0.1318	0.0577	0.4117	0.2831	0.0176	0.0000	93.9541
Total	**0.6650**	**1.2050**	**93.5035**		**0.6275**	**2.4965**	**0.0417**	**0.2330**	**0.0847**	**0.5045**	**0.2802**	**0.0379**	**0.0140**	**99.7025**

INDEX TO TOBACCO CULTURE.